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Advancing Free Trade
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APEC Innovation City Study Report

APEC Policy Partnership on Science, Technology and Innovation

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Preface

The concept of *innovation city* is supposed to describe those cities driven by innovation performances, which are leading to their economic growth. And the innovation performances mostly include the strategy of regional integration, design and establishment of technology parks and clusters, as well as science, technology and innovation (STI) development including some specific fields closely related to the city. Some terms like smart city, green city, etc. are sometimes occurring more frequently, but they can also be certified to branches of innovation city.

For most APEC member economies, innovation city is an emerging concept helping them on cross-border collaboration and economic growth. Those developed economies like the United States already got typical and well-known cases, like Silicon Valley in San Francisco, and developing economies are attempting to make such plans following, for instance, several different areas in the People's Republic of China (PRC) are busying working on their regional integration missions.

In 2019, APEC announced its priorities for the year of Chile, which contains Integration 4.0 and Sustainable Growth.[1] The priorities are highly related to physical, institutional, and people-to-people connectivity, which is also an essential theory of regional integration. Based on this background concept, the Project Overseer (PO) and its collaborative organization from PRC jointly submitted and applied the project of *Promoting Innovation City Development in APEC Region and Cooperation to Contribute to Regional Integration 4.0 and Sustainable Growth* (official project code: PPSTI 02 2019A), and got it approved finally.

This project is designed to discuss the development and assessment of innovation city-related performances in the APEC region, operated cross three years from 2018 to 2021 (extended from 2020 due to the Covid-19 pandemic), and was cosponsored by eight APEC member economies including Australia; Republic of Korea (ROK); Malaysia; Mexico; Papua New Guinea; Peru; Russia and Thailand.[2] Tianjin Science and Technology Exchange Center as the PO of the project is an official institution supervised by the City of Tianjin, PRC, and its collaborative organization International Technology Transfer Network (ITTN) is a professional organization promoting international STI cooperation and exchange since 2011.

There are two events within the project period, and this study report is based on the contents of the first one named APEC Innovation City Forum, which was held in the City of Nanjing, PRC in July 2020. More than 50 experts from 14 economies attended the discussion around three

[1] APEC Chile. (2018). *Background Paper: Integration 4.0*. [PDF file]. Available at: http://mddb.apec.org/Documents/2018/SOM/ISOM/18_isom_006rev1.pdf.

[2] Tianjin Science and Technology Exchange Center. (2019). *Proposal of Promoting Innovation City Development in APEC Region and Cooperation to Contribute to Regional Integration 4.0 and Sustainable Growth*. Available at: https://aimp2.apec.org/sites/PDB/Lists/Proposals/DispForm.aspx?ID=2415.

main topics. The first topic was Innovation City Development and Assessment, in which speakers were experts working for existing innovation city assessment indicator systems. The second topic was International Innovation City Development- Cluster, Region and Carrier Construction, and the last one was APEC Innovation City Showcase. The last two topics are designed to collect typical innovation city cases.

The logic of the study report is following these main topics, listing the comprehensive descriptions for each system and case, to produce realistic results and references for the region accordingly. In the end, the report will provide several policy recommendations for APEC member economies, which will also be an important part of the completion report of the whole project.

Part I Innovation City Assessment Indictor Systems in the APEC Region

Through this part, the report is going to introduce and analyze several existing innovation city assessment indicator systems in the APEC region, especially those who showed their work on the Nanjing Event. Since an assessment system is intended to serve accountability purposes, different systems created and operated by various groups are using their indicators for distinct purposes. And those groups mostly contain research institutions, consulting firms and governmental think tanks. The research institutions and think tanks always do these assessments for policy and strategy making, while consulting firms deliver valuable results according to the assessments and provide them for potential customers.

In order to collect materials and discuss with the creators directly, the project team sent invitations to well-known institutions that released reports on innovation city study, as well as other international organizations. To be specific, the report owners in this part include *Kearney Management Consulting* (the United States), *Shanghai Institute for Science of Science* (Shanghai, PRC), *Higher School of Economics* (National Research University, Russia), *the Organization for Economic Co-operation and Development* (OECD), and *ZGC Tianhe Technology Promotion Center* (Beijing, PRC).

1. What are those systems assessing?

According to the classical concept of Triple Helix concept[3], academies (or universities), industry, and government are the three main forces to an innovation system. And three basic elements are contained in it, which is a more prominent role for the university in innovation, on a par with industry and government in a knowledge–based society. It is a movement towards collaborative relationships among the three major institutional spheres, in which innovation policy is increasingly an outcome of interaction rather than a prescription from governments. In addition, to fulfil their traditional functions, each institutional sphere also “takes the role of the other” to performe new roles. Institutions taking non-traditional roles are viewed as a major potential source of innovation in the process of innovation.

Based on the common understanding of this concept for innovation performances, this chapter is going to give a glance at how people are assessing innovation cities, especially what they are accessing in those assessment indicator systems. And before coming into details, it is necessary to understand more about what innovation means to evaluate an economy or a city’s development. In other words, what are those assessment systems mainly evaluating? The answer will also be the reference for the project team to choose objects of study. Overall, most of those assessment systems are about innovation capacities, environment for science, technology and innovation, development of technologies highly related to cities’ infrastructures. Innovation city cases selected in Part 2 of this study report all contain these elements.

[3] Vidya Hattangadi. (2019). *What is the Triple Helix Model for Innovation*.
Available at: https://drvidyahattangadi.com/what-is-the-triple-helix-model-for-innovation/.

In the table below, some main terms are listed under three tasks:

Table 1: Main Terms about the Concepts of Innovation City

Innovation Capacity	Environment for Science, Technology and Innovation	Technology Fields related to Cities' Infrastructures
•Scientic Resaerch •Education Resources •Technology Commercialization •Innovation Enterprenurship •STI Parks and Clusters •Intellecual Property Rights •etc.	•Living Insurance for Talents •Culture and Policy •Industry Basis •Capital and Fiancial Services •Cross Border Exchange •etc.	•Information Technology •Climate •Sustainable Development •Transportation and Vehicle •Construction •etc.

2. Typical Assessment Systems and Their Indicators

2.1 Global city competitiveness and leaders in innovation by *Kearney Management Consulting*

Kearney Management Consulting is a leading global management consulting firm with more than 90 years of history and 61 offices in major commercial cities in 40 economies. As one of KEARNEY's global pillar businesses, the government and regional development practice has served more than 60 economies and regions in the world and delivered more than 1,000 related projects, many of which are flagship projects in the economy/city.[4]

Since 2008, the *KEARNEY Global Cities Report* has been tracking the world's top-performing cities. The report is a comprehensive and in-depth analysis of global cities, providing insights into their global reach, performance, and level of development. In the beginning, it was a joint study by KEARNEY, the Chicago Council on Global Affairs, and Foreign Policy magazine. Now it has been divided into two series, the Global Cities Index (GCI) and Global Cities Outlook, and both of them are quantitative measures.

[4] Pengyuan Zhou. (2020). *Global city competitiveness and leaders in innovation.* Kearney Management Consulting.

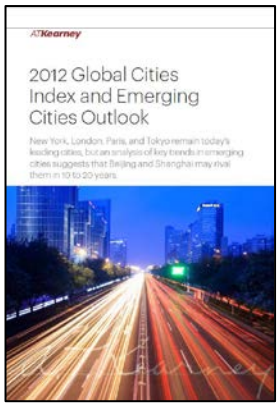


Figure 1. Kearney's Global Cities Report on 2012

Figure 2. Kearney's 2019 Global Cities Report (the latest report by July, 2020)

There are five dimensions in Kearney's Global Cities Index (GCI) assessment, which are Business Activity, Human Capital, Informational Exchange, Cultural Experience, and Political Engagement. And the assessing process is using a scaling methodology to give final scores to each city. Furthermore, 27 metrics are measured across these five dimensions. See below:

- Business Activity (30%): capital flow, market dynamics, and major companies present;
- Human Capital (30%): education levels and availability of internationally accredited schools;
- Information Exchange (15%): access to information through the Internet and other media sources;
- Cultural Experience (15%): access to major sporting events, museums, and other expos;
- Political Engagement (10%): political events, think tanks, and embassies;

As for Global City Outlook, there are four dimensions and 13 metrics, see below:

- Personal Well-Being (25%): safety, healthcare, inequality, and environmental performance, etc.;
- Economics (25%): long-term investments and GDP, etc. ;
- Governance (25%): a proxy for long-term stability through transparency, quality of bureaucracy, and ease of doing business, etc. ;

- Innovation (25%): entrepreneurship through science and technology performances, etc.

Figure 3: Leading Cities in Asia-Pacific Region in Kearney's 2019 Report

However, since Kearney chooses its theme independently for Global Cities Report every year, not all of the reports were focusing on innovation cities; instead, sometimes the reports were much more comprehensive. When Kearney chose innovation as the theme, it identified four modules to excel for cities in the innovation. See below:

Economic Powerhouses (Beijing as one example)

- Established hubs for trade and finance;
- High level of business activity;
- Easy access to capital and investors;

Industry Leaders (Boston, Moscow as examples)

- Dominant business industry(ies);
- Robust university systems in that particular industry(ies), producing technically trained professionals;

Networked Centers (Los Angeles, Toronto as examples)

- Prominent universities that produce a talented citizenry;
- Close ties between the academic and business communities;
- Start-up incubated by the preeminent firm;

Regional Hubs

- Most stable governments and economies in their regions
- Cultural centers with younger and more liberal populations
- Governmental grants & policies to accelerate innovation

Kearney gave one typical example, San Francisco, to explain its indicators above. For Industry Leaders, Silicon Valley has laid the foundation since 1955 in San Francisco; For Networked Center, Preeminent universities, such as Stanford University, establish a stable partnership

with large companies in Silicon Valley; As for Regional Hubs, Silicon Valley becomes a community of young, liberal PhDs who could draw in other young people, making it a regional hub; and for Economic Powerhouse, San Francisco gradually becomes the economic powerhouse: major corporations establish a presence; VC takes hold, ensuring access to funds for the area's entrepreneurs. And all these four modules should be thought connected to each other, which makes it into a circle.

Figure 4: Kearney's typical case of San Francisco (the United States)

In order to evaluate city-level innovation performance, Kearney believes that identify the linkage between indicators is a beneficial approach. The reports select and screen the evaluation indicators from three stages: input, process and output, evaluating the capacity and production factors in each process, and identifying their advantages and disadvantages in the end.

2.2 Scientist's Ideal City Global Survey Report by *Shanghai Institute for Science of Science*

Shanghai Institute for Science of Science (SISS) is one of China's earliest soft science research institutes established in January 1980. The Institute for Science of Science is a public welfare institution of scientific research serving decision-making on innovation as the tenet, sticking to demand guidance, problem guidance and application guidance, and focusing on fields such as STI strategies, public policies and industrial technology innovation. The institute combines soft science and hard science, integrates research and consulting, and is dedicated to building a high-level professional platform-type STI think tank with special characteristics.[5]

SISS also chooses different themes every year to establish the "Ideal Cities" report. In 2018, it entrusted Springer Nature to develop the questionnaire survey facing the first-line scientists of major economies around the world (654 complete questionnaires were collected, most of which were filled in by associate professors and above), in order to understand the main reasons why scientists worldwide choose the cities and regions to live, work and start businesses, as well

[5] Xueying Wang (2020). *Scientist's Ideal City Global Survey Report*. Shanghai Institute for Science for Science.

as the main factors of a city to attract international high-end scientific and technological innovation talents.

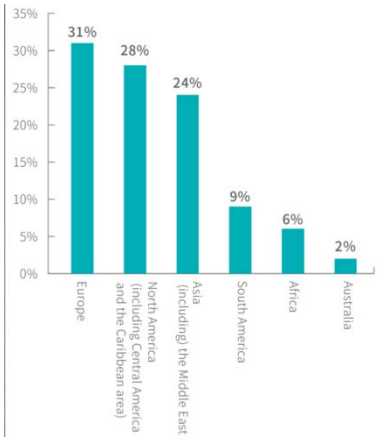


Figure 5: SISS's Objects Distribution for Questionaries

Figure 7: SISS's Latest Report *2018 Ideal Cities for Global Scientists* (released in 2019)

Figure 8: SISS's Latest Report *2019 Ideal Cities for Innovation Sources* (released in 2020)

Scaling tables are used with fixed indicators as well for "Ideal Cities" reports as its research methodology, and it could be found that SISS is using Likert scales for counting the results. In its 2018 report for scientists, 11 indicators (including "others") occurred in the questionnaires to count scientists' main considerations to choose an ideal working city. Those indicators included leading research institutions, leading research infrastructure, rich research fund, etc. For the same reason, 12 indicators were counted to confirm scientists' key considerations to choose an ideal city to live, including open and inclusive urban culture, living convenience, modern/beautiful/fashionable city, etc. According to SISS's study, leading research institutions and open and inclusive urban culture are the two most important conditions for scientists to choose an ideal city.

Among those indicators, SISS also lists specific advantages for each city to show their features visually, and these advantages give cities different shapes in the report.

Figure 9: Cities with their Advantages and Shapes in "Ideal Cities" Reports

SISS's latest study in 2019 was based on Nature's Global Innovation Index, and there was a significant conclusion that the top 20 science, technology and innovation center cities in the world are now delivering more than 25% overall outcome of high technology.

2.3 HSE Global Cities Innovation Index by *Higher School of Economics*

HSE (Higher School of Economics) is one of the finest universities in Russia and it is highly ranked on several university rankings, such as QS and the Times Higher Education. Consistently ranked as one of Russia's top universities, HSE University is a leader in Russian

education and one of the preeminent economics and social sciences universities in eastern Europe and Eurasia. Having rapidly grown into a well-renowned research university for over two decades, HSE University sets itself apart with its international presence and cooperation.[6]

As an early phase study on innovation cities, HSE announces to create a new vision of modern cities, and it is taking more consideration on innovation ecosystem and its relation to city innovations. When identifying the innovation ecosystem of a global city to involve creators of solutions and technologies attracted, by advanced infrastructure and a friendly environment, HSE was drawing a picture on the whole system and trying to evaluate cities' innovation performance accordingly.

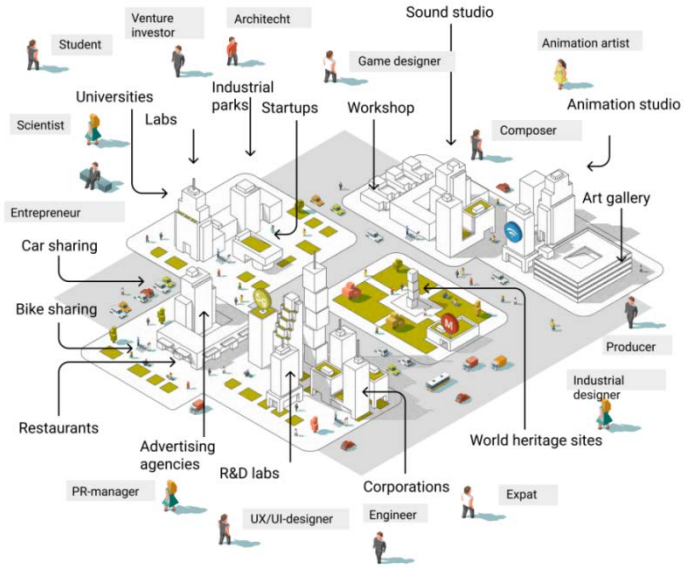


Figure 10: HSE's Glance on Innovation Ecosystem of Cities

HSE's Global Cities Innovation Index accepts multifaceted metrics of global cities' innovative appeal and a complex approach to evaluate urban innovation activity, see below:

Technology Innovations

- Corporations
- Startups
- Universities and Scientific Institutions
- Innovative infrastructure

Creative Industries

- Fashion
- Film Industry
- Games

[6] Evgeniy Kutsenko. (2020). *HSE GLOBAL CITIES INNOVATION INDEX Creating a new vision of modern cities*. Higher School of Economics.

- PR and Advertising
- Industrial Design
- Architectures
- Culture and Art

Infrastructure Development

- Transport and Digital Infrastructure
- Mobility
- City Services
- Institutional Environment (the costs of living and doing business, business activity and innovation values)

According to those indicators above, HSE is going to provide a ranking based on factors for attracting and retaining technology entrepreneurs, scientists, architects, designers and other smart solution experts. HSE's selection of global centers for innovation includes both capitals and agglomerations. The ranking is going to contain 36 innovation cities, which are chosen leading cities by specific selection criteria (patents and scientific publications, presence in other rankings, and completion data). As for the approach for data collection, HSE decides to collaborate with other institutions, e.g., Fortune 500 Global, IMDb, Steam, TripAdvisor.

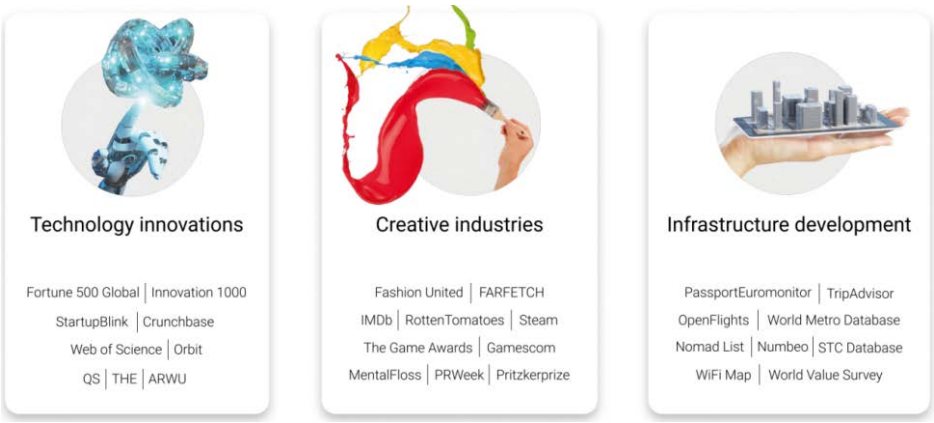


Figure 11. Database for HSE's Global Cities Innovation Index

HSE also announced to release an official completion version of the report by 2021.

2.4 Enhancing Innovation Capacity in City Government by *Organization for Economic Co-operation and Development (OECD)*

As Australia; Canada; Chile; Japan; ROK; New Zealand; Mexico; and the United States are members of both APEC and OECD, these studies would be able to help the APEC region on innovation cities research and assessment. OECD was invited as a special speaker for the project as OECD is running a position of authority on innovation study in the modern world.[7]

[7] Tadashi Matsumoto. (2020). *Enhancing Innovation Capacity in City Government*. The Organisation for Economic Co-operation and Development (OECD).

OECD introduced its important study on cities' innovation performance, and showed very robust ability on theoretical research. The report *Enhancing Innovation Capacity in City Government* focuses more on economies' policies and official performance on promoting STI. In the meaning time, OECD has other related reports focusing on specific technologies of innovation city cases, like *Smart Cities and Inclusive Growth*, which is supported by the Ministry of Land, Infrastructure and Transport of ROK.

Figure 12: OECD's Report *Enhancing Innovation Capacity in City Government*

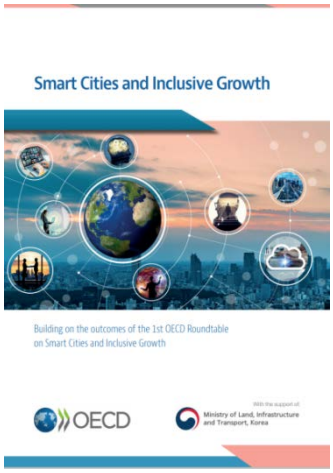


Figure 13: OECD's Report *Smart Cities and Inclusive Growth* (Supported by Ministry of Land, Infrastructure and Transport, ROK)

OECD supports urban policy through three main tools, which are identified as: 1) providing comparable international data for urban and metro areas; 2) preparing urban policy and metropolitan reviews and other thematic works on cities; 3) developing policy networks both at the different level where leaders can share their experience and learn from each other.

As the OECD report is mostly a qualitative analysis, for those cities who supported the report, OECD lets them fill in surveys with these questions below:

Definition, goals & approaches

- What does innovation capacity mean and look like in your city administration?
- What are your city's goals, strategy and approaches?

Organization & structure within the municipal administration

- How is innovation is organized within the municipal administration, so you have designated staff for innovation?

Funding for innovation capacity

- What are the funding and resources dedicated to developing and maintaining innovation capacity?

Data for innovation

- How is your municipality generating, managing and sharing data?

Innovation outcomes

- What are the broader outcomes of your city's innovation strategy on people, places & firms?

Figure 14: Cities in both APEC member economies and OECD members that support the report

As a result, OECD found that the most commonly mentioned terms that most associates with public sector innovation are Experimentation, Human-centered design, Data analytics, and Big picture re-thinking. Based on the survey and result, OECD proposes three main blocks and their indicators for assessing innovation cities:

Organizational Arrangements

- Leadership
- Innovation Team
- Dedicated Funding

Data Management Capability

- Capacity to collect data

- Capacity to analyze data
- Access to technology

Openness to Partnership

- Partnerships
- Citizen interaction

The organizational arrangements refer to how the formal and informal institutional structure of municipalities can either foster or hinder innovation. The data management capability relates to cities' ability to harness digital technologies to promote workplace efficiency, develop evidence-based policies and improve service delivery. Openness to partnership means the capacity of municipalities to communicate and work with different actors outside the public sector. Each of these building blocks is distinct from each other but interdependent because a municipality's approach to one domain inevitably reverberates into the others.

According to those facts, OECD is able to answer these deeper questions below:

- How does your city approach innovation capacity?
- Who provides funding to support cities' innovation capacity?
- Are cities achieving their innovation goals?
- What are your innovation efforts helping your city do better?
- What is driving innovation in cities?

OECD gave its objective next on 2020-2021, which is to assess how innovation capacity and the use of data in city governments have a tangible impact on resident well-being outcomes.

2.5 Evaluation of the Maturity of Urban Economic Innovation Development Capability (E-MUE) by *ZGC Tianhe Technology Promotion Center*

ZGC Tianhe Technology Promotion Center is a non-profit organization registered in Beijing. Since it was founded in 2014, ZGC Tianhe has strived to build a professional third-party service platform for the transformation of scientific and technological achievements, which has formed around the "demand-side, supply-side and service-side" to benefit the innovation performance of the region.[8]

[8] Nan Zhu. (2020). *Evaluation of the maturity of urban economic innovation development Capability (E-MUE)*. ZGC Tianhe Technology Promotion Center.

■ 评价模型

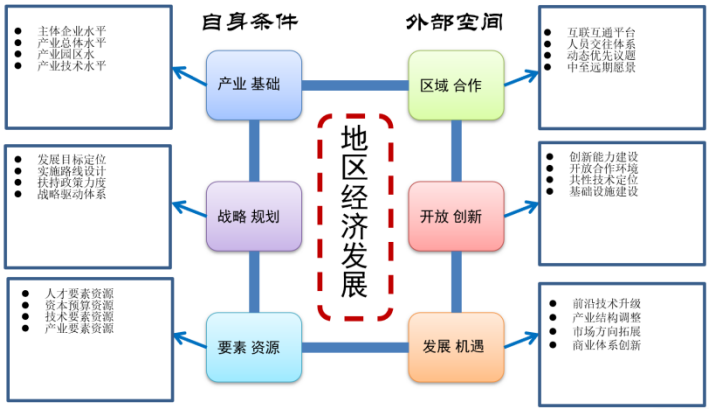


Figure 15: ZGC Tianhe's Evaluation Model on Regional Economic Growth

ZGC Tianhe worked out an assessment system, Evaluation of the Maturity of Urban Economic Innovation Development Capability (E-MUE), to give a comprehensive evaluation for innovation city in the APEC region. The assessment system integrates three mature evaluation criteria, including Technology Commercialize Adaption Maturity (T-CAM) , Enterprise Creative Updating Maturity (E-CUM), and Industrial Creative Updating Maturity (I-CUM). These criteria were successfully established based on the current development of China's scientific and technological accomplishment transformation and integration of TRL (techonology readiness level) system, AD2 system and Delphi Technologies' scoring mechanism.

ZGC Tianhe's evaluation model contains six main modules, see below:

Industrial Foundation

- Main Enterprise Performance
- Overall Performance
- Industrial Zone Performance
- Industrial Technique Level

Strategic Planning

- Targets Location
- Design of Implementation Plan
- Supporting Policy Implementation
- Strategy-driving Mechanism

Productive Factorial Resource

- Human Resource
- Capital Budgeting Resource
- Technical Resources
- Industrial Resources

These main indicators above are identified as a region's internal conditions, which is one important part of evaluating the innovation performance. And the indicators below are external conditions, which is another part of the model.

Regional Cooperation

- Connectivity
- Interpersonal Communication Model
- Dynamic Topics
- Short-term and Long-term Visions

Open Innovation

- Innovation Capacity Building and Training
- Open Environment for Cooperation
- Generic Technology Positioning
- Basic Infrastructure Establishment

Development & Opportunities

- Frontier Technology Upgrade
- Industrial Structure Adjustment
- Market Extension
- Innovation in Commercial system

There is one fact needed to be clarified that ZGC Tianhe designed this evaluation model after they had got the Project's invitation. As a result, it could be a demo for assessing innovation cities in the APEC region as well as a first draft system which is required to be further researched.

2.6 Other Assessment Systems and Their Indicators

Apart from those reports which were comprehensively introduced during the Nanjing Event, some other assessment reports are studied by the Project Team as well for further reference. And due to the language background, most of these reports are from institutions in PRC. In this part, some reports that are worth studying are listed in the table below with main analyzing modules and indicators, as supplements to this specific chapter.

Table 2: Other Assessment Systems and Their Indicators

Reports	Main Modules and Indicators	Notes
2thinknow City Rankings – Innovation Cities™ Index	- Cultural Assets - Hard and Soft Infrastructures for Innovation - Internet-connected Markets	The index continues to be divided into 31 segments, 162 indicators and 1,200 data points.

Nature Index 2020 Science Cities	- Number of Journal Publications	The report selected 82 scientific research papers published in high-quality natural science journals. Those papers were selected by 58 independent groups of in-service scientists, based on survey feedback of more than 6,000 scientists around the world.
Annual report on China's Innovation Development 2017 -2018	- Innovation Environment - Innovative Resources - Innovation Outcomes - Innovation Benefits	Detailed indicators for data analysis: - the proportion of industrial enterprises with experience in R&D activities (%) - the proportion of R&D expenditure in GDP (%) - the number of R&D personnel per 10,000 people (person-year/10,000 people) - the number of invention patents authorized per 10,000 people (piece/10,000 people) - the proportion of high-tech industry output value in GDP (%) - 1/unit of GDP energy consumption (10,000 yuan/ton of standard coal).
National Innovative Cities Innovation Capacity Evaluation Report 2020	- New Governance Capacity - Original Innovation Capacity - Technological Innovation Capacity - Technology Commercialization Capacity - Innovation-driven Capacity	Based on the analysis, cities can be classified into three categories: the birthplace of innovation, the growth pole of innovation, and innovation agglomerations.
Annual Report of China's City Innovation 2019	- Innovation Environment - Innovation Support Capacity - Innovation Culture Capacity - Technology Transfer Capacity	32 indicators were selected totally.
Report on Regional Innovation Capacity Evaluation of China 2020	- Enterprise Innovation - Innovation Performance - Knowledge Creation - Knowledge Acquisition - Innovation Environment	20 second-level indicators, 40 third-level indicators and 138 fourth-level indicators were selected, and the regional innovation capacity was divided into innovation strength, innovation efficiency and innovation potential.

Evaluation Report of National High-tech Zone Innovation Capability 2019	- Accumulation of Innovative Resources - Environment for Innovation and Entrepreneurship - Performance of Innovation Activities - Internationalization of Innovation - Innovation-driven Development	Each area includes five second-level innovation indicators.
China Urban Innovation and Entrepreneurship Environmental Assessment Report	- Policy Elements, Industrial Elements - Talent Elements - R&D Elements - Financial Elements - Intermediary Services	Six first-level indicators, 13 second-level indicators and 18 third-level indicators were selected to evaluate the index system.
Report on Evaluation of China Innovation Cities 2018	- Innovation Conditions - Innovation Investments - Innovation Activities - Innovation Impacts	11 second-level indicators and 32 third-level indicators were selected and the report ranks the participating cities separately.

3. Common Characters among the Systems

As a summary of this chapter, some common characters of the assessment systems could be listed as references, which is for a specific system in the future assessing innovation cities in the APEC region. In a short, these are the commons below:

a. Most of the assessment reports are using scales as their statistical and present tools, there are at least two levels of indicators in these tables, and some are using Likert scale to establish the analytical models;
b. The modules contain serval main contents, including the abilities on STI research, industrial capacity, intern environment of the city/region (e.g., culture, capitals, human resources support), external environment of the city/region (e.g., connectivity, openness, international exchange), and specific technologies with related infrastructures;
c. According to what most researchers are concentrating on, the technologies of information, climate, energy, building, and transportation have the closest connection to cities' innovation development, which lead to some particular concepts like Smart City;
d. Capitals and supports for people to live are important influential factors for innovation cities' development. Instead, culture and politics are not primary factors;
e. These reports or the owning institutions are using these assessment results to give a ranking for innovation cities in the region, which would provide references for governments' policy-making and decisions.

In the next chapter, the study report is going to enter into details of specific innovation city cases, referring to the information discussed above. Some of those cases are relevant to policies or

strategies like regional integration, and others are about particular technologies or infrastructures, or even key factors like intellectual property rights management.

Part II Innovation City and Regional Integration Cases in the APEC Region

1. City Innovation Development and Regional Integration Strategy of APEC Member Economies

For better performance, the Project Team collected some strategic materials relevated to innovation city, which were adopted by developed and developing APEC member economies, such as:

- **Australia**

Innovation and Science Australia (ISA), an independent statutory board of entrepreneurs, investors, researchers and educators that advises the Australian government on innovation, research and science matters, published a document named *Australia 2030- Prosperity Through Innovation*. It's a strategy report that ISA developed to advise the Australian government on "how to generate and capture more of the benefits of innovation for Australians".[9] The *Australia 2030- Prosperity Through Innovation* ("Australia 2030" for short) defines five strategic imperatives including:

- Education: respond to the changing nature of work by equipping all Australians with skills relevant to 2030;
- Industry: ensure Australia's ongoing prosperity by stimulating high-growth firms and raising productivity;
- Government: become a catalyst for innovation and be recognized as a global leader in innovative service delivery;
- Research & development: improve R&D effectiveness by increasing translation and commercialization of research;
- Culture & ambition: enhance the culture of innovation by launching ambitious Missions.

All five imperatives correspond to a certain aspect critical to innovation city development: education- talent, industry- enterprises, government- city planning and infrastructure construction, R&D- innovation, culture & ambition- attraction of the city.

- **Canada**

According to *Strategic Roadmap 2018-23*[10] published by Canada Foundation for Innovation (CFI, Canada's principal mechanism for funding the research infrastructure), it is Canada's objectives to "increase Canada's capability to carry out important world-class scientific research and technology development", and "promote productive networks and collaboration among

[9] Innovation and Science Australia. (2017). *Australia 2030- Prosperity through Innovation*. Available at: https://www.industry.gov.au/data-and-publications/australia-2030-prosperity-through-innovation.
[10] Canada Foundation for Innovation. (2018). *Strategic Roadmap 2018-23*. [PDF file]. Available at: https://www.innovation.ca/sites/default/files/file_uploads/cfi-strategicroadmap-2018-2023-en.pdf.

Canadian universities, colleges, research hospitals, non-profit research". Innovation city could be a perfect platform for the implementation of the objectives. Innovation cities are essentially favorable platforms for universities, colleges, research hospitals and non-profit research for their close physical distance and strong connection with different parts of the innovation ecosystem attracted by different aspects of innovation cities. Such integration could easily turn into a productive network of innovation entities that could give birth to world-class scientific research and technology development.

- **The People's Republic of China (PRC)**

Beijing, Shanghai and Shenzhen have become three highly attractive innovation cities in China to worldwide science and technology practitioners. The three cities are respectively at leading position for Beijing- Tianjin- Hebei Coordinated Development cluster, Yangtze-River Delta cluster and Guangdong Province - Hong Kong, China (HKC) - Macao, China Great Bay Area (Greater Bay Area) cluster.

According to *2018 Scientist's Idea City Global Survey Report*[11] introduced by Mr Wang Yingshi on the first event of PPSTI 02 2019A, Shanghai has become the most desirable Chinese city for scientists worldwide to work because of Shanghai's open and inclusive urban culture, as well as good research conditions and innovative culture. This is a very referable innovation city development case for developing economies in Asia-Pacific, even the whole world.

- **Malaysia**

Malaysia proposed the 4th Industrial Revolution, Society 5.0 and Sustainable Development Goals. The Sustainable Development Goals is planned to be involved in Malaysia's medium-term development plans and its Shared Prosperity Vision 2021-2030, which include 15 guiding principles and eight enablers.

Dr Azmizam Abdul Rashid from Urbanice Malaysia introduced in his presentation that "as Malaysia continues to move towards a high-value, knowledge-based economy with a strong focus on the services and manufacturing sectors, innovation will be crucial to raising the overall efficiency and thus productivity of each sector." It is obvious that urbanization and innovation city would be two important topics for future planning and development of Malaysian cities.

- **The United States**

The United States has one of the most influential and classic innovation city clusters, Silicon Valley, which is even more well-known than the actual city that it locates in. As a developed and advanced economy, innovation is still a powerful tool for the United States to address most

[11] Shanghai Institute for Science of Science. (2018). *2018 Scientist's Idea City Global Survey Report*. Shanghai, China.

pressing challenges. While many APEC economies can grow by adopting existing technologies and business practices, the United States must continually innovate because workers and firms are often operating at the technological frontier. The *Strategy for American Innovation* firstly issued by President Obama defines six key elements, including creating quality jobs and lasting economic growth, catalyzing breakthroughs for priorities, delivering innovative government with and for the people, fueling the engine of private sector innovation, empowering a nation of innovators and investing in the building blocks of innovation.[12] The benefit of innovation city in talent and resource integration as well as public-private sector collaboration makes it a perfect match to the elements. Smart city is listed in Strategy for American Innovation as one of nine areas of innovation opportunities together with advanced manufacturing, clean energy and advanced vehicles.

2. Innovation City and Regional Integration Cases in the APEC Region

2.1 Perth, Australia

Western Australia is an important role in the world's global innovation ecosystem. As the world becomes increasingly interconnected, innovation and technology become agents of change, Western Australia is fully prepared to become an innovative state in Australia, taking advantage of its unique geographical location and industrial advantages to tap into the regional and global innovation economy.

- **Overview: Perth's New Smart City Innovation Plan**

In 2017, the city received a matching funding grant of $1.3 million through the Australian Government's Smart Cities and Suburbs Program, which launched four projects: Smart Precinct, Smart Irrigation, Smart Sustainability and Data Hub.[13]

The Smart Precinct trial was fitted with closed-circuit television-based sensors and analyses to measure vehicle and pedestrian activity around the new Matagarup bridge and Optus stadium.

The Smart Irrigation project replaced inefficient systems with sensors and more than 100 intelligent controllers that automatically adjust watering to weather.

The Smart Sustainability project complements this environmental monitoring with a range of water and air quality sensors near schools and universities that help communities participate in smart city technologies.

[12] National Economic Council and Office of Science and Technology Policy. (2015). *A Strategy for American Innovation* [PDF File]. Available at: https://obamawhitehouse.archives.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf.

[13] City of Perth to embrace Smart technology. (2017). Available at: https://perth.wa.gov.au/news-and-updates/all-news/city-of-perth-to-embrace-smart-technology.

Finally, **the Data Hub** is an open data portal that helps citizens make informed decisions on their business and stimulates innovation in Perth's growing start-ups and technology sectors. In October 2018, the Committee for Perth released *Bigger & Better Beyond the Boom: Perth's Pathway to Prosperity to shape Greater Perth's economic future*.[14]

A key recommendation of the report is to 'implement the "smart city" initiatives to improve infrastructure efficiency, improve living capacity and urban competitiveness'. The core of the action is to investigate the implementation of smart cities elsewhere and to work with local innovation industries and research institutions to develop "smart cities" programs for Greater Perth.

These Smart Cities projects are designed to test the application of devices and smart technologies in real-life environments. the resulting insights will be of value to citizens, businesses, and the environment, putting Perth at the forefront of Smart innovation.

The new technology aims to improve the quality of life and provide a knowledge platform for Perth's residents, tourists, businesses and technology start-ups. The government of the city works with selected technical partners to improve habitability, productivity, sustainability and economic development. The secret to the success of the Perth Smart City project is to "think about the common values of the community ".

- **Technology and Data**

1. Citizen Science Environmental Monitoring

As part of Perth's smart city innovation program, it is working with citizen scientists to encourage research, collaboration and innovation using smart devices connected to the internet, commonly known as the "internet of things" or the internet of things T.

To initiate community engagement, the city provided participating civic science organizations (schools, universities, and community groups) and connected solar environmental sensors to the internet. Sensors collect observation data from air, water or soil and can be remotely monitored from IoT applications. Historical data will be available on the open data portal for further analysis.

2. City of Perth Free Public LoRa Network

The city of Perth is providing free public outdoor wireless LoRange (lora) network services to citizen scientists, residents, community groups and businesses as part of its smart city engagement program to promote learning and innovation of smart devices (collectively referred to as the "Internet of Things" or IoT) connected to the network.

[14] Committee for Perth. *Bigger & Better Beyond the Boom-Perth's Pathway to Prosperity to shape Greater Perth's economic future*. Available at: https://www.committeeforperth.com.au/documents/bigger-better-beyond-the-boom-perths-pathway-to-prosperity.

LoRa networks are perfect for anyone that wants to buy or build their own LoRa compatible smart devices that need to be connected to the internet to monitor and/or control devices through client applications. These devices can be used to control, track, or perceive certain aspects of a business, home, or environment.

Lo Ra devices send messages at unauthorized wireless band frequencies that are freely available and the city's public network will receive and forward messages from devices using Australian AU915 bands. Anyone with LoRa compatible AU915 devices can use the city's LoRa network without having to pay for ongoing network access.

The city will install seven LoRa network gateways that will be connected to the Internet via the Internet of things (TTN). TTN is a free global open LoRa wide area network (LoRa WAN) server provider where you can register your LoRa device to start recording data from your sensor. TTN is a community-based organization that provides information and forums for you to start using LoRa technologies and actively participate in the "Internet of Things".[15]

3. Open Data Portal
The open data portal in Perth will provide a platform for data sharing and collaboration for a range of users, including citizen scientists, the public sector (such as other local government authorities), business and retail businesses, entrepreneurs and innovators, residents and community groups.

Perth City collects all kinds of information about its services, utilities and assets. by making these data publicly available, it is expected that it can be used to generate insights, ideas and opportunities that bring benefits to the city as it continues to develop as a vibrant place for work, life and access. These data can be used for any purpose, such as raising public awareness, mixing with other data for analysis or modeling, loading into business applications, or supporting ideas and innovations. The goal is to publish non-sensitive council data on key aspects of urban life and work - environmental, security, social and economic - online, which will increase transparency, improve public services and support social and economic initiatives.

2.2 Toronto-Waterloo Innovation Corridor, Canada

- **Background and Objectives**

Toronto is the fourth-largest city in North America. It is 112 kilometers from Waterloo and takes about an hour and a half by the highway. In the Innovation Corridor, there are more than 200,000 high-tech employees who have worked for about 15,000 tech companies and over 5,000 start-ups. The Toronto-Waterloo Innovation Corridor includes several surrounding cities, such as Guelph, Hamilton, Kitchener, and Mississauga. The Waterloo region as a high-growth economic zone in southern Ontario is composed of a dense cluster of advanced manufacturing and technology companies.

[15] Smart Cities: Data stories. Available at: https://perth.wa.gov.au/live-and-work/smart-cities.

According to the report by McKinsey & Company[16], the PPP-adjusted GDP per capita gap between the United States and Canada has grown from $4,000 in 1990 to over $11,500 in 2015. One of the initial focuses is to help Canada shorten the GDP per capita gap with the United States. In other words, Canada aims to shrink the gap with the rest of the world. Therefore, Canada utilizes its own advantages to develop Toronto-Waterloo Innovation Corridor and become an innovative city. This report will describe the advantages of Canada and the challenges or limitations of Canada's Toronto-Waterloo Innovation Corridor.

- **The Advantages**

1. Talent Pool

A large number of universities and incubators can meet the needs of the growing cluster. The Toronto-Waterloo Corridor holds an excellent talent pipeline, with 423,000 work-ready graduates across 16 tertiary colleges. The Waterloo region has three famous colleges and institutions: the University of Waterloo which is a prestigious science and engineering school, Wilfrid Laurier University which is a prestigious business school, and Conestoga College, as well as Perimeter Institute for Theoretical Physics (the world's outstanding scientist Dr Stephen Hawking once worked here), Centre for International Governance Innovation (CIGI), Mike & Ophelia Lazaridis Quantum-Nano Centre (the world's first research center that researches both quantum computing and nanotechnology donated by Mr Lazaridis, the founder of BlackBerry phones), the United Nations System Academic Committee.

The other universities including the University of Toronto, McMaster University, York University, Ryerson University, Conestoga Christian School and the University of Guelph. Start-up incubators including Communtech, MaRS, The University of Waterloo's Velocity, Ryerson University's DMZ (formerly the Digital Media Zone), Rotman School of Management's Creative Destruction Lab and other entrepreneurial centers at the University of Toronto. Those colleges and institutions provide a lot of talent for enterprises, start-ups and scale-ups located at The Toronto-Waterloo Corridor.

2. Substantial Cost Advantages

Waterloo has substantial cost advantages compared to other North American locations, such as Toronto, New York City, and San Francisco. It leading the world research and development with lower research and development costs than the United States, about 27.8%.[17] Moreover, Waterloo is the lowest overall business costs in Canada, France, Germany, Italy, Japan, the United Kingdom and the United States, called as G7. Waterloo is a 35% less hiring cost and four times of retention rate than San Francisco. In addition, the salary of a software engineer is 50% less than in San Francisco base on the lower cost-of-living. It means that the companies can spend less in the Waterloo region.

[16] McKinsey & Company. (2016). Primer on technology superclusters and a fact base on Canada's Toronto-Waterloo Innovation Corridor.
[17] Waterloo EDC. Available at: https://www.waterlooedc.ca/en/advantages-of-waterloo/cost-advantage.aspx.

3. Waterloo Region's Ecosystem

Waterloo region integrated different innovation clusters, such as cognitive computing, image recognition, smart robotics and so on.[18] It shows the diversity of the Waterloo region. The diversity of the clusters can attract the venture capital can cooperation between the clusters.

Advanced and Emerging Technologies[19]

- **Challenges/ Limitations**

1. Lack of experienced employees

Although the Waterloo region has an excellent talent pool, it still lacks talents with hands-on experience. A survey conducted by the Lazaridis Institute shows that 53% of industry stakeholders believe the core barrier of scaling tech companies in Canada is the insufficiency of executives and managerial talents. This report suggests that the Toronto-Waterloo Innovation Corridor creates a broad and deep talent pool by training the existing talent of the skills they lack, such as how to commercial the achievement. Moreover, the Canadian government can offer some policies for foreign talent to attract the talent who own the skill of how to commercial the inventions or achievements.

2. Lagging in terms of commercialization

Canadian universities account for a large proportion of total research and development in Canada. While it has a number of the world's leading research universities, it lags of transferring research prowess or achievement to commercial success. It may because of the IP ownership and management rules and revenue-sharing requirements, and University's inflexible rule for the faculty. There are lots of university and college retain IP ownership, the decision power of transfer of technology, as well as to keep a share of future revenue from the research completed on campus. In addition, there are numbers of the university have the strict or inflexible rules for

[18] Ryan Mounsey (2020). Canada's Toronto-Waterloo Innovation Corridor. Asia-Pacific Economic Council, APEC Innovation City Forum. As cited in McKinsey & Company (2016). Primer on technology superclusters and a fact base on Canada's Toronto-Waterloo Innovation Corridor.
[19] CDA Ryan Mounsey_Toronto Waterloo Innovation Corridor_APEC July 19 2020_updated.pptx

faculty, such as do not offer a leave of absence, or provide access to business mentors with the expertise required to commercialize their inventions. It may limit their entrepreneurship to pursue business development or extension.

- **Conclusion**

To conclude that Toronto-Waterloo Innovation Corridor has several advantages, such as a talent pool, substantial cost, and the Waterloo region's ecosystem. However, there are stills have some challenges which limited those advantages. It is required to solve those challenges to better develop Toronto-Waterloo Innovation Corridor and become an innovation city.

2.3 Chile

Chile has served as an important leading role in Latin American, with its information and communication technologies in public administration management. As the capital of Chile, Santiago is known as a sustainable, competitive and smart city. In the IESE Cities in Motion Index, Santiago has displayed significant improvement in the economy, public management, and governance. With the increasing economic strength, Chile has attracted investors and entrepreneurs worldwide. The Chile innovation policies also provide a friendly environment for start-ups and initiatives. The Chilean government is striving for a transformation from an economy mainly boosted by natural resources to a more sustainable one.

Among all the innovations in Chile, the Intelligent transportation system is a leading initiative. The department of Transportation and Telecommunications has taken detailed consideration to advance their transportation system. The combination of artificial intelligence and ICTs with transportation has made this system more comprehensive and smart. The introduction of shared micromobility and autonomous vehicles has invigorated the whole system and will render Chile a more promising future.

- **Shared Micromobility**

Shared micromobility refers to the services that provide the public with shared vehicles for transportation purposes. In Chile, it includes station-based and dock-less bike share, and scooter share. Shared micromobility requires efficient public policies, the mastery of new technologies, thus it would a Challenge.

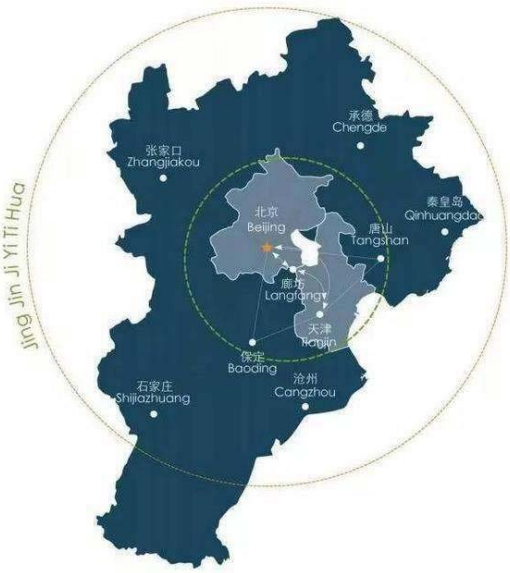
- **Intelligent Transport Systems (SIT)**

SIT is a process that trying to incorporate new practices and technologies into transport systems. The implementation of SIT will improve the existing SCATS (Sydney Coordinated Adaptive Traffic System) project and strengthen territorial coordination. At the same time, the travel experience of citizens will be improved. A more advanced traffic control system is vital in SIT, for it will better traffic management and ease congestion in urban areas. The use of data analytic and digital technologies will help to transform mobility planning and management. Big data and AI technology have enabled the transportation system to make better decisions on trip planning and travel patterns for users.

- **Autonomous Vehicles**

Chile has made comprehensive preparation for the development of autonomous vehicles. The autonomous vehicles are equipped with DGPS, 4G connectivity, Lidar and Emergency stop button. The safety of these vehicles was among the top concerns, so the user information system was constructed, and furnished with facilities for disabled people. The vehicle Pilot in Santiago is an all-encompassing plan. The vehicle Pilot is tested on private use road with controlled conditions. It is also the first autonomous vehicle Pilot in Latin American.

2.4 The Beijing-Tianjin-Hebei City Cluster, China



The Beijing-Tianjin-Hebei city cluster includes the capital Beijing, municipality Tianjin and province Hebei. The total area is about 216,000 square kilometers. accounting for 2.3% of China, a resident population of 110 million people at the end of 2018, accounting for 8.1% of China, and a regional GDP of 8.5 trillion yuan, accounting for 9.4% of the China.

The Beijing-Tianjin-Hebei city cluster plans to find different areas in the region to focus on their comparative advantages to avoid duplication, achieve regional complementarity and maximize the synergistic effect. Areas within the Beijing-Tianjin-Hebei region already have their own strengths in specific areas.

As the capital, Beijing has a prominent political status, profound cultural heritage, leading technological innovation, dense talent resources and close international contacts. Tianjin is known as northern China's logistics center. It has the largest comprehensive port in the north, a strong manufacturing base, strong R&D and transformation capability, and good development momentum. Hebei is known for its heavy industries. It is rich in natural resources, a relatively abundant labor force, a good industrial base, large economic volume with a broad development space.

Based on the functions and industrial development positioning of the capital Beijing, municipality Tianjin and province Hebei, around the construction and enhancement of "two + four + N" industrial cooperation pattern, this project focuses on building several undertaking platform carriers with outstanding advantages, distinctive features, complete supporting facilities, strong carrying capacity and great development potential.

"Two" is two agglomerations: Beijing Municipal Administrative Center and Xiong'an New Area, which actively absorb and gather innovative resources and elements, create innovative industrial clusters, and promote the integration of industry and city, as well as the balance of jobs and housing.

"Four" is four strategic cooperation functional areas: Caofeidian Collaborative Development Cooperation Demonstration Zone, Beijing Daxing Airport Economic Zone, Tianjin Binhai New Area, and Zhangcheng Ecological Function Zone;

"N" is 46 specialized and characteristic undertaking platforms, divided into three fields of modern manufacturing, service and agriculture.

In terms of patent applications, from 2014 to 2018, the total number of jointly granted patents in Beijing, Tianjin and Hebei was 4,278. Among them, the number of jointly authorized patents in Beijing and Tianjin was 1,798, accounting for 42.0%; the number of jointly authorized patents in Beijing and Hebei was 2013, accounting for 47.1%.

From the perspective of the technology market, from 2014 to 2018, the turnover of technology contracts exported from Beijing to Tianjin and Hebei increased from 8.32 billion yuan to 22.74 billion yuan, with an average annual growth rate of 28.6%; the proportion of the turnover of technology contracts exported from Beijing to Tianjin and Hebei increased from 4.8% to 7.5% of the turnover of technology contracts flowing to other provinces and cities.

The pattern of the industrial division of labor in the Beijing-Tianjin-Hebei economic circle is becoming clearer. The trend of high-end industries in Beijing is obvious, and the positioning of cultural center and technology innovation center is becoming more prominent. Hebei's advanced manufacturing industry is developing rapidly, and the secondary industry has obvious advantages.

2.5 Chengdu-Chongqing Economic Circle, China

The Chengdu-Chongqing Economic Circle has a population of 10 million and is the fourth China’s economic strategic growth pole after the "Beijing-Tianjin-Hebei City Cluster", "Yangtze River Delta City Agglomeration", and "Greater Bay Area". It is the golden zone for the development of the western region, which will bring rare development opportunities such as the development of transportation and the gathering of new population.

As a strategic support and construction highland for high-quality development in the west of China, the Chengdu-Chongqing Economic Circle is tasked with the mission of building a technology innovation center with influence in terms of innovation development. At the same time, its regional innovation is also an important part of the great cycle of domestic innovation. Chengdu-Chongqing Economic Circle relies on the "twin cores" of Chongqing and Chengdu and regional central cities, strengthens the links with neighboring cities, forms a number of city clusters with strong radiation drive, close economic ties and reasonable system structure, optimize urban functions and realizes dislocation development.

- **Strengthen Transportation Network Construction**

According to the *Development Plan of Chengdu-Chongqing City Cluster*, a "five-frameworks and 18-auxiliary" intercity network will be formed in the Chengdu-Chongqing City Cluster to realize one-hour access between the "twin cores"(Chengdu and Chongqing), one-hour access between core cities and secondary center city, and two-hour access between all secondary center cities in the city cluster.

- **Strengthen Information Network Construction**

Information network construction is an important carrier and effective platform for information exchange in Chengdu-Chongqing Economic Circle, to accelerate information resource sharing and promote collaborative innovation. The information network construction of Chengdu-Chongqing Economic Circle starts from the following three aspects:

1. Chengdu and Chongqing focus on 5G, industrial Internet and data centers to build a benchmark area for new infrastructure construction and take the lead in building a first-class new infrastructure construction service system. By 2022, Chengdu and Chongqing intend to build 200,000 5G base stations, the scale of the 5G industry is expected to exceed 20 billion yuan, and the coverage rate of key areas of the 5G network will strive to reach more than 80%.

2. The extensive construction of E-government. By breaking down the administrative barriers and departmental barriers, all regions and departments could join hands to establish a unified regional portal. This can save resources and improve the quality of the construction of the website, as well as achieve region-wide information disclosure and improve the timeliness of the information and the responsiveness of various regions and departments.
3. Strengthen the integration of information resources and establish a unified public service platform of geographic information. Promote the application of intelligent technology, realize the interoperability and sharing of transportation and information between Chengdu and Chongqing city clusters, and build an integrated, high-quality smart city cluster, forming the premise and foundation to support technology collaborative innovation.

In order to create a model platform for cooperation, Chengdu-Chongqing Economic Circle has built the Western (Chongqing) Science City, the Chengdu-Chongqing Science and Technology Innovation Corridor and the Chengdu-Chongqing National Science Center to achieve the clustering and integration of innovation resources. The overall cooperation network shows a trend of growth in size, partnership, and cohesiveness.

2.6 Greater Bay Area, China

The Greater Bay Area includes the two Special Administrative Regions of HKC and Macao, China, as well as the nine cities of Guangzhou, Shenzhen, Zhuhai, Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing in Guangdong Province. The total area is about 56,000 square kilometers.

The development of the Greater Bay Area has been given a key strategic planning status in China's development blueprint, having great significance for China's implementation of innovation-driven development and commitment to reform and opening up. The goal is to further deepen cooperation among Guangdong province, HKC and Macao, China, give full play to the comprehensive advantages of the three places, promote deep integration within the region, promote coordinated regional economic development, and develop an international first-class bay area that is pleasant to live in, work in, and travel.

HKC, Macau, Guangzhou and Shenzhen as the four core cities as the core engines of regional development, continue to play the comparative advantages in striving for excellence and achievements, and strengthen the radiating effect in leading the development of nearby regions.

To support Zhuhai, Zhongshan, Huizhou, Foshan, Dongguan, Jiangmen, Zhaoqing and other cities to give full play to their own advantages, deepen reform and innovation, enhance the comprehensive strengths of the cities, the formation of distinctive features, complementary functions, competitive and important node cities. To enhance the coordination of development, strengthen the interaction and cooperation with core cities, drive the development of the surrounding distinct characteristics, and jointly raise the quality of development of the city clusters.

By 2035, the region is expected to play a leading role in multiple industries, including advanced manufacturing, shipping, innovation, trade, and finance.

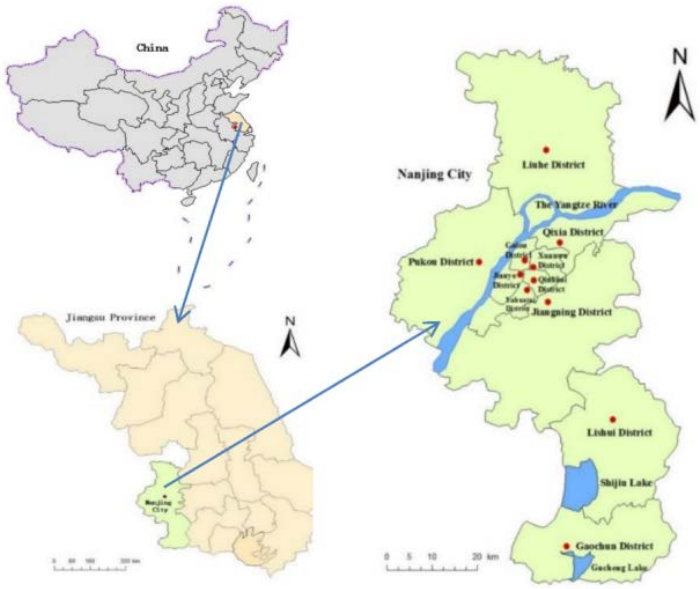
The Shenzhen-Zhongshan corridor, which will be completed in 2022, is an eight-lane highway to reduce traffic and improve travel time. These three key transportation infrastructure projects support the GBA, laying the foundation for improved connectivity between three of the world's largest ports. These projects will integrate the Bay Area into a formidable transportation hub.

The strength of the Greater Bay Area is the cooperation across cities in R&D and innovation. For example, Traditional Chinese Medicine Science and Technology Industrial Park between Guangdong province and Macao, China on Hengqin Island in Zhuhai; HKC-Shenzhen Innovation and Technology Park in the Lok Ma Chau Loop. Both examples take advantage of Shenzhen's R&D and innovation potential while leveraging HKC's strong legal system and attractive business environment.

2.7 Nanjing-Jiangning District, China

- **Background**

Located in the east of China and along the lower reaches of the Yangtze River, Nanjing is the capital of Jiangsu Province. It is a modern city with a strong industrial foundation and has a GDP of over one trillion RMB. At present, Nanjing is vigorously implementing an innovation-driven development strategy, focusing on building an innovative city with a global influence. It is building comprehensive science centers and technology and industry innovation centers and building a first-class innovation ecosystem.



Talent is one of the most important resources that innovation development of the city relies on. In recent years, many cities in China have formulated and issued policies to attract talents. As

a mega-city in the Yangtze River Delta and an important central city in the Eastern Region, Nanjing has a good performance in terms of economic development level, environment for scientific and educational innovation, public service level, and natural ecological environment. Focusing on the requirements of industrial transformation and upgrading, Jiangning high-tech Zone continuously optimizes the talent introduction and cultivation mechanism, and focuses on bringing in leading talents and innovative and entrepreneurial teams with international vision and capabilities.

With the introduction of the “Ningju Plan” and other policies to attract talents, and the implementation of a series of policies to optimize the environment for the development of talents, the work of attracting talents in Nanjing Jiangning district has achieved remarkable results.

- **Measure:**

1. A task force

The government leaders have personally contacted academicians and youth talents and set up a task force to solve various problems in the process of talent introduction and cultivation, which fully reflects the central position of talent policy in innovation policy. Nanjing has formulated a series of talent policies, such as “Nanjing 321 Entrepreneur Talents Plan”.

2. Research Funds

The government has established a science and research fund for young engineers in enterprises to support them develop technology research by aiming at industry and market needs. At the same time, it has established a technology innovation and entrepreneurship fund in order to support enterprises to create doctoral stations.

3. Initiatives and Programs

The "Ning Ju Plan", namely gathering talents in Nanjing, was implemented for young university students. This plan absorbs more than 200,000 university students each year to work and start their own businesses in Nanjing, implements one-stop services, and actively implements policies to support employment and entrepreneurship.

4. Implementation of the talent referral system

The government implemented a talent referral system to introduce talents, which depends on a “Nominating Committee” to make referral discissions. The committee is composed of leading talents from leading enterprises, new R&D institutions, science and technology intermediaries, financial investments, etc. The recommended talents can enjoy corresponding preferential policy treatment.

5. Construction of “Talent Apartments”

Talent settlement policies were established by adopting rental subsidies, housing grants, and other settlement methods to provide all kinds of talents with security for housing.

The core of sustainable innovation capacity is the continuous accumulation of innovative talents, i.e., a continuous supply of innovative talents. In the process of building a world-class innovation

city, Nanjing attaches great importance to the cultivation of innovative talents, constantly optimizes the structure of innovative human capital, and builds the city's sustainable innovation capacity through the "input-output" cycle of innovative talents resources.

2.8 APEC Blue Economy-Xiamen, China

The Ocean is one of the life support systems of the Earth. The survival, development and prosperity of human beings depend on the marine ecosystem, which provides all kinds of products and services. The rich natural resources in the ocean provide a good material basis for the rapid development of the human marine economy. Since the middle of the 20th century, due to the rapid development of society and economy, the continuous expansion of population, and the continuous increase of urbanization, the contradiction between land-based development and resources and environment has become increasingly fierce. The exploitation and utilization of marine space, resources, and environment, to further promote the development of the marine economy has gradually become one of the important strategies of APEC economies.

Since the 1970s, the marine economy has gradually become a brand-new economic growth point in the APEC region. The development achievements of the marine economy have made great contributions to economic development. For example, the marine economy accounts for 48% of the APEC member's GDP and contributes 60% to the coastal region's economy (APEC Oceans Conference, 1998). In China, the coastal provinces account for more than 25% of China's GDP, of which the marine economy contributes more than 25% to the economy of coastal provinces and cities.

- **Blue Economy Concept**

The blue economy is a new development concept and model, and various international organizations have made different interpretations and understandings of the blue economy. According to the World Bank[20], the blue economy is the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem." The EU defies blue growth as "the long-term strategy to support sustainable growth in the marine and maritime sectors as a whole." For APEC, APEC's Oceans and Fisheries Working Group (OFWG) views the blue economy as an approach to advance sustainable management and conservation of ocean, coastal, ecosystems and sustainable development to foster economic growth.

- **A Case Study of Xiamen, China**

As a key city in China's reform and opening-up, Xiamen has made remarkable achievements in its development over the years. Xiamen is located at the junction of the waters of the South and East China Seas, with HKC to the south and Chinese Taipei to the east, forming an

[20] The World Bank. What is the Blue Economy? Available at: https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy.

important economic and industrial belt. Xiamen has a marine area of 390 square kilometers, more than 30 islands of various sizes, and a coastline of 230 kilometers. Its rich fishery resources and dense port resources provide the foundation for the economic development and development of Xiamen's marine industry. At the same time, Xiamen is one of the earliest special economic zones in China, and the only free port and direct shipping city on the Strait approved by the central government, which has a perfect framework for marine use and management, and an outstanding development environment and utilization strategy.

Ports are one of the key development aspects of the blue economy industry. Xiamen has an advantageous geographical location and belongs to a highly concentrated industrial economic zone. It is imperative for the construction of the port. Its deep-water port is strategically located for construction and the port water area is wide. Its natural conditions provide favorable conditions for the development of the port.

The transition from traditional marine industries to environmentally-friendly marine industries was promoted. The main contents are as follows:

1. Promoting the development of cruise, yacht, and sailboat

Xiamen International cruise center was officially put into use on 28 June 2008, has an annual reception capacity of 1, 500 thousand passengers and a peak handling capacity of 3,000 people at one time. Xiamen is one of the biggest yacht production bases nationwide, and one of the biggest distribution centres of yachts and sailing ships.

2. Development of coastal tourism

City tourism has become a popular industry nowadays, compared to city tourism, marine tourism is still in the exploration stage, and its development and utilization of space and potential are huge. Based on the advantages of Xiamen's marine environment resources, vigorously promoting Xiamen's marine tourism will become an important economic breakthrough.

3. Marine environment protection and ecological restoration

Beaches restoration and man-made beach projects were launched to restore the coastal landscape and improve the grade of tourism besides shoreline transformation.
Promoting the sustainable development of the marine industry.

As an important coastal city in China, Xiamen has outstanding advantages in marine resources and has a good foundation for the development of marine economic industries. With the development of society and economy, the blue economy has gradually become one of the most important economic development themes in all APEC economies. Through the practical exploration of the blue economy, a new model of blue economy development with regional characteristics will be formed, which will promote the blue economy development of Xiamen and China, and provide scientific references for the economic development of marine resources in APEC economies.

2.9 Hong Kong, China (HKC)

HKC, largely surrounded by water, is susceptible to the impacts of the climate crisis. Like many economies, HKC is facing climate issues such as rising temperature, more frequent heavy rain, and rising sea surface. For example, during the passage of Typhoon Mangkhut in 2008, the sea level at Victoria Harbour increased to about 4 meters. As early as 2030, much of HKC's central business district would be damaged by extreme storm tides. Key financial services, including HKEX, HSBC, and Standard Chartered, as well as critical city infrastructures, such as HK Port and HK West Kowloon Station, could be hit by flooding.[21]

Facing such extreme conditions, the HKC government has started to create a climate-resilient innovative city to better tackle with challenges climate change may bring. The overall strategy of the government is to develop an eco-system of collaboration involving the Private Sector, City Government, NGOs and above all the Community to address climate change and to underpin resilience initiatives. To build a resilient city, main climate change risks need to be identified. Areas normally covered include coastal protection, water and waste management, biodiversity, public health, food supply, and essential services and infrastructure.

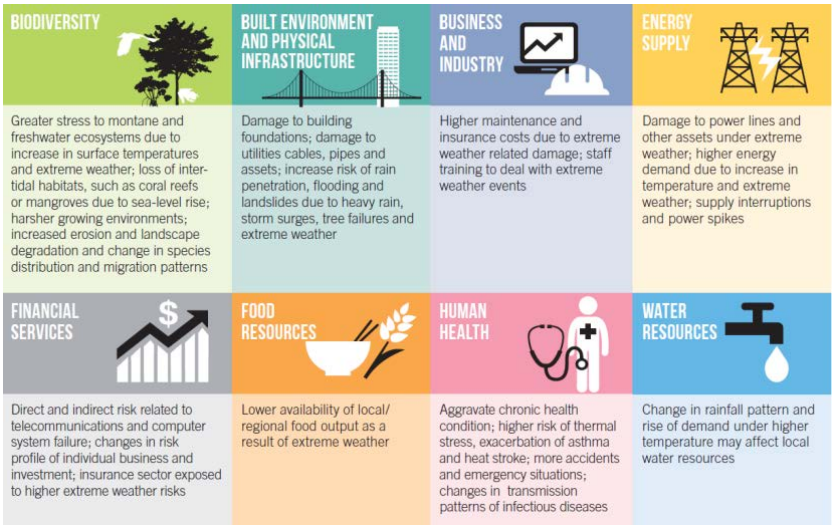


Figure 1. Possible Major Climate Change Impacts Affecting HKC[22]

To respond to climate change and create an innovative resilient city, this article will discuss responding measures and initiatives raised by the HKC government in terms of infrastructure development, public awareness and shareholder engagement, government data access and usage, as well as ESG reporting and green investment.

[21] Dharisha Mirando and Debra Tan. (2019). *No-Sense Climate Strategies: From DSD to HSBC*. Available at: https://www.chinawaterrisk.org/resources/analysis-reviews/no-sense-climate-strategies-from-dsdto-hsbc/.

[22] Environment Bureau. (2017). *Hong Kong's Climate Action Plan 2030+*. Available at: www.climateready.gov.hk/files/report/en/HK_Climate_Action_Plan_2030+_booklet_En.pdf.

- **Infrastructure Development: Blue-Green Infrastructure and "Sponge City"**

Drainage Service Department (DSD) is striving to implement the "Blue-Green Infrastructure" concept to enhance HKC's flood resilience. The concept aims to mimic the natural water cycle through infiltration, evaporation, and transpiration to capture rain, control floods and reuse stormwater. Thus, the city will be able to retain rainwater for beneficial use rather than funneling it directly to the sea. These efforts include planting in nullahs and rivers, engineering natural stream settings, preserving river ecosystems, and introducing landscape design to promote biodiversity and environmental beautification while maintaining drainage capacity. Besides, DSD introduces the concept of "sponge city" to promote rainwater infiltration and reduce surface runoff through flood accumulation and retention. A portion of the stormwater is collected and then used for optimizing water recycling and enhancing HKC's flood resilience.

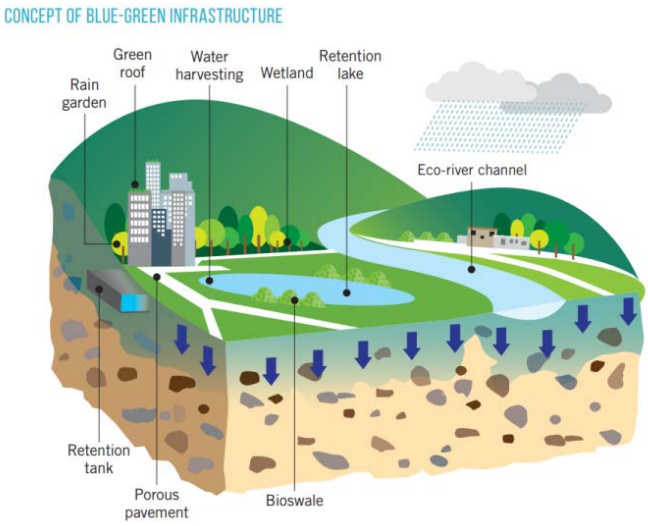


Figure 2. Variety of blue-green infrastructure and solutions in a "sponge city" concept. ***Illustration from Drainage Services Department.***[23]

- **Public Awareness and Shareholder Engagement**

Climate resilience requires not only efforts in mitigation and adaptation but also in strengthening the social response to climate-related risks and emergencies. Thus, it is vital to raise awareness of climate impacts and resilience measures across the whole of society. To raise public awareness of climate change, the government has stepped up publicity and education.

In addition to disseminating relevant materials through the media, promotional posters, and roving exhibitions, there is a dedicated website (https://www.climateready.gov.hk) that serves as a one-stop platform for sharing the latest information on climate change. The environment and Conservation Fund (ECF) has also been set up to support non-profit organization educational activities and demonstration projects. In addition, the city launched a large-scale

[23] Environment Bureau. (2017). *Hong Kong's Climate Action Plan 2030+*. Available at: www.climateready.gov.hk/files/report/en/HK_Climate_Action_Plan_2030+_booklet_En.pdf.

public education campaign, “Safer Living 2.0”, in June 2019 to raise public awareness of natural disasters, stimulate community efforts and build community resilience.

- **Access to and Use of Data**

The HKC government is now establishing a Common Spatial Data Infrastructure (CSDI) for working as an information infrastructure to share geospatial data and support city initiatives. Through the data infrastructure, bureaus, departments and private sectors can access timely geographical location information to facilitate the development of spatially enabled, community-centric applications and services. By the end of 2022, the government is expected to roll out CSDI for public use, thus citizens could access various maps and other map services including free mobile applications.

- **ESG Reporting and Green Investment**

In 2019, the total value of green bonds issued in HKC was HK $78 billion (US $10 billion), and by the end of 2019, the total amount of green bonds issued in HKC was HK $202.8 billion (US $26 billion).[24] In addition, HK$7.8 billion (US$1 billion) of green bonds with a borrowing ceiling of HK$100 billion (US$12.8 billion) were issued in support of HKC’s sustainable development.

Furthermore, the Hong Kong Stock Exchange (HKSE) is demanding greater disclosure on environmental, social, and corporate governance (ESG) issues from its listed companies. As greater transparency enables enterprises to identify opportunities more effectively to reduce operating costs and enhance governance, risk reduction and growth from sustainable development, therefore, more disclosure is expected to attract more Western investors to invest in HKC.

2.10 Keihanna, Japan

[24] Climate Bonds Initiative. (2019). *Hong Kong Green Bond Market Briefing 2019*. Available at: https://www.climatebonds.net/resources/reports/hong-kong-greenbond-market-briefing-2019.

- **Introduction**

The Keihanna Science City (officially known as the Kansai Science City) is nestled in the green Keihanna hills stretching over Kyoto, Osaka, and Nara prefectures in western Japan. On the 15,000 ha of land of Keihanna Science City, 12 cultural and scientific research districts (about 3,600 ha) are distributed. Keihanna Science City is located about 30 kilometers from the center of Kyoto and Osaka cities, and approximately 10 kilometers from the center of Nara City. With more than 150 research facilities, including universities and cultural facilities, and a total workforce (researchers and other staff) of nearly 10,000, the city has made remarkable achievements in the fields of culture and scientific research. The purpose of creating the Keihanna Science City is to create world-class innovation and vitalizing the region Keihanna.

- **Features of the Keihanna Science City Construction:**

1. The Active Involvement of the Private Sector.

In order to successfully develop the Keihanna Science City, effective collaboration between the citizens and private sectors in the academic, industrial, and administrative fields is essential. This project makes use of "private sector vitality" as much as possible, allowing each sector to use its own strengths and functions.

2. The Cluster-type Development.

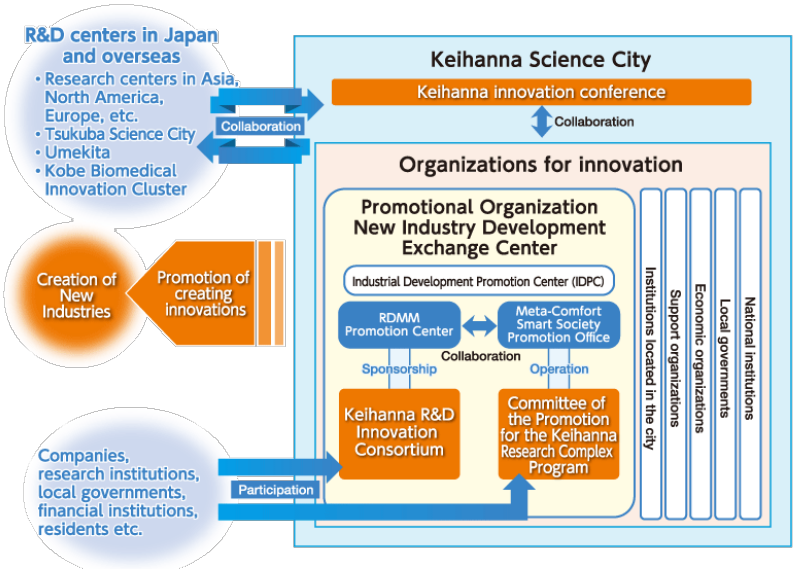
In order to promote environmentally friendly development among the existing cities and towns, as well as a balance between forestry, agricultural fields and the natural environment, the Keihanna Science City has adopted a cluster development plan with 12 cultural and scientific research districts dispersed. Besides, the city seeks to unify the entire city by assigning each district urban function that capitalizes on its strengths.

3. Development with a Fusion between Housing and the Cultural and Scientific Facilities.

The Keihanna Science City construction involves the development of cultural and scientific facilities as well as residential areas. The goal is to build an attractive city with a remarkable fusion of academic space and living environment, taking advantage of the convenience of a large city with many residents. In such a city, collaborative research between institutions and citizens will be made possible by encouraging citizens to participate in scientific studies and demonstrations.

The Keihanna Science City has a strong international network among companies, research institutes and universities around the world, with strong global channels of communication. International interactions among researchers are also very active.

The city is striving to create new industries in the fields of information and communication, environmental and energy, medical and biotechnology, taking advantage of the city's potential for knowledge integration and innovation.

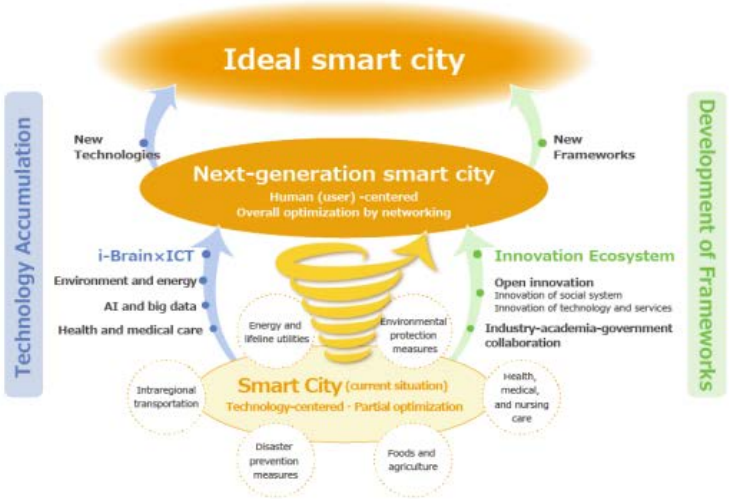


Keihanna Science City[25]

In Keihanna Science City, various institutions and organizations are providing detailed hands-on supports to small and medium-sized enterprises and venture companies. They are also promoting industrial development based on innovative research and development.

Keihanna Science City is working on the establishment of sustainable innovation schemes based on open innovation such as the "RDMM promotion center" and the "Keihanna Research Complex".

- **About Keihanna Research Complex:**

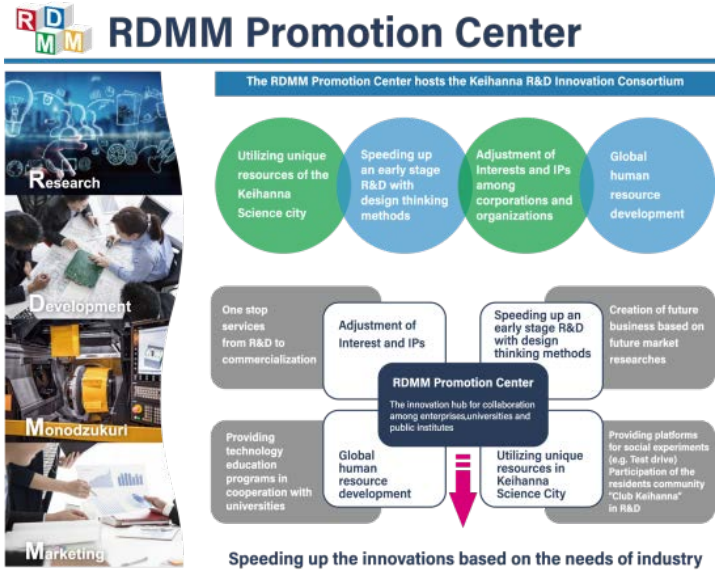


Approach to achieving Keihanna RC's vision[26]

[25] Keihanna Science City. *Creation of new industries from Keihanna Science City*. Available at: https://www.kri.or.jp/en/whats_keihanna/creation/.
[26] Keihanna Research Complex. Available at: https://keihanna-rc.jp/en/business/.

Based on the technologies that Keihanna Science City has developed over many years, "i-Brain x ICT"[27] is to create a framework for cultivating new business aimed at an innovation ecosystem and creating a next-generation smart city with 'Meta-Comfort,' which aims to generate empathy in people's hearts. The project is being promoted with a variety of tools: integrated R&D in different fields; human resources development; commercialization support; equipment sharing; and an innovation hub & overall promotion.

- **About RDMM Promotion Center:**



The RDMM Promotion Center[28]

The RDMM (Research & Development for Monozukuri through Marketing) Support Center serves as a hub of the network for the creation of a steady stream of innovations. It supports R&D for the manufacturing and service industries while keeping an eye on market trends. It aims to create new industries and businesses which fully utilize their strengths.

2.11 Republic of Korea (ROK)

ROK's economy is highly concentrated. About 48% of ROK's GDP comes from the capital area: Seoul, Incheon, and Gyeonggi province. The headquarters and major R&D centers of the top 10 companies and 74% of listed companies are also located in the capital area. Therefore, the government has decided to create new sources of economic growth outside the capital area through newly built Innovation Cities.

"Innovation City of ROK" was born out of the Korean government in 2005, which planned to promote more equitable growth by decentralization. The 10 innovation cities in ROK are

[27] *i-Brain: Brain and human science technologies, or a set of technologies that quantitatively and objectively measure people's feelings and emotions based on analysis of human psychology, behavior, and brain and biological data.
[28] Keihanna Science City. Available at: https://www.kri.or.jp/en/rdmm/.

designed around the 176 public institutions which were deliberately chosen based on complementary with the local economy, relocated from the Seoul area, and structured to encourage the growth of small and medium-sized enterprises in related industries.

By selecting a theme associated with regional industry, the Korean government has constructed a total of four types of innovation cities, thus making each innovation city a place with unique regional characteristics.

1. A city Creating Innovation through NetWork among industry, Academia, Research Institution and Government Innovation Hub City.
   -Drive regional development by connecting relocated public agencies with regional strategic industry.
   -Create new growth engines for regional development by clustering of industry, academia, research institution and government.

2. A City with Regional Theme Specialized City with Unique Characteristics.
   -Create regional and industrial brands for each innovation city.
   -Create landmark and unique images to enhance regional identity.

3. A City where Everybody wants to Live in Environmentally Friendly Green City.
   -Preserve the natural environment and secure diversity & circulation of the ecosystem.
   -Establish sustainable urban spatial structure and transportation system that conserve energy and resources.

4. A City with a good educational environment and creative exchange Educational & Cultural City.
   -Create a good educational environment through upgrading educational conditions including the establishment of special-purpose high schools.
   -Display elegant city culture combined with regional characteristics and beautiful landscapes.
   -Create U-City equipped with a high-tech city operational system to be in line with a knowledge-based era.[29]

For example, Busan Innovation City serves as a center for film, fishing, and finance, and is centered on related public institutions such as the ROK Institute of Ocean Science and Technology, the ROK Film Council, and the ROK Asset Management Corporation.

The innovative city in North Jeolla Province is known as "Agricon Valley", planning to create a hub for biotechnology and agriculture by taking advantage of the region's association with traditional agriculture.

[29] https://innocity.molit.go.kr/v2/eng/submain.jsp?sidx=106&stype=1.

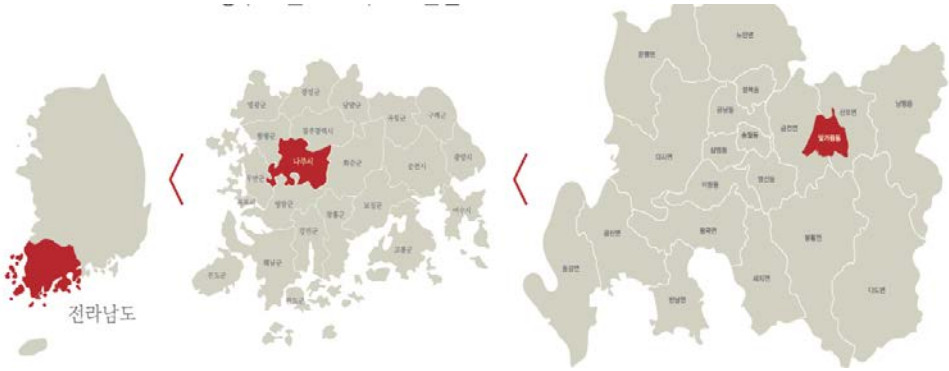
The Korean government has divided the size of innovative cities into three stages of development.

First Stage (2007~2012 Completion of relocation plan)
About 2,500~4,000 employees of relocated public agencies and relevant industries and some 15,000~25,000 families

Second Stage (2012~2020 Completion of relocation of industry, academia and research institution)
About 4,000~8,000 employees of relocated private companies, universities and research institutions and some 25,000~50,000 families

Third Stage (2021~2030 Spread of innovation)
Due to increased clustering, the number of jobs and induced population will vary from region to region[30]

- **Case study of Kwangju/Jeonnam Inno City:**



Kwangju/Jeonnam Inno City is the capital of High-Tech Futuristic Industrial Cluster, as a joint innovation city will be promoted as a cultural capital merging with the regional economy by forming an industrial cluster of energy, IT and culture & art industries.

The government has built up a cluster of metropolitan energy industries in Gwangju, to foster a new hub of ROK's energy industry, and to cooperate with the development of research institutions related to energy technology and clean energy such as new and renewable energies.

In Jeonnam, it has relocated the agricultural industry function group, strengthening the local development strategy centered on city characteristics, and playing the role of a locomotive to promote the development of local strategic industry, agriculture, and biotechnology industry to upgrade the agricultural structure.

The government wants to make Kwangu/Jeonnam Inno City a new hub for ROK's energy industry, a center for agriculture and bio-industry, a leading arts and culture cluster and a competitive ICT network cluster among public institutions, universities and companies.

[30] https://innocity.molit.go.kr/v2/eng/submain.jsp?sidx=106&stype=1.

The construction of Innovation City in ROK will lay the foundation for balanced territorial development where everybody can live in harmony together. It is also can promote region-specific development and facilitate regional economic development.

2.12 Malaysia

The Malaysia Smart City Framework (MSCF) was launched as a guiding document of Malaysia's Smart City development in 2019, aiming at improving the living condition of citizens and stimulate its economy, among other objectives. Urban dwellers in Malaysia are facing many social ills like congestion, pollution, poor infrastructure. In this Framework, ICT (information and communication technology) and technological advances will be employed to address those problems. This framework is a solution to urban issues and will serve as a stimulus to Malaysia's sustainable growth.

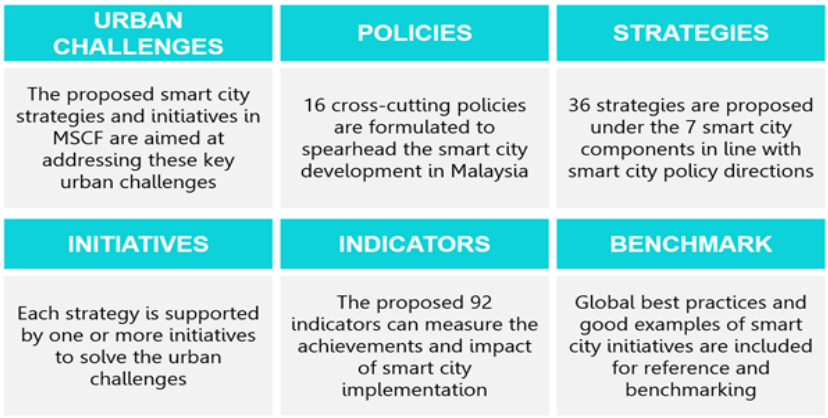


Figure 1: The Malaysia Smart City Framework (MSCF) content[31]

This initiative is consisting of many different components, including economy, infrastructure, environment, government, citizens and so on. Achieving the goal of this initiative requires the support of Malaysia's government policy, strategy, and pilot cities. Among all the components, the economy and digital infrastructure are the backbones of this initiative.

[31] The Malaysia Smart City Framework (MSCF). Available at: https://malaysia.gov.my/portal/content/30947.

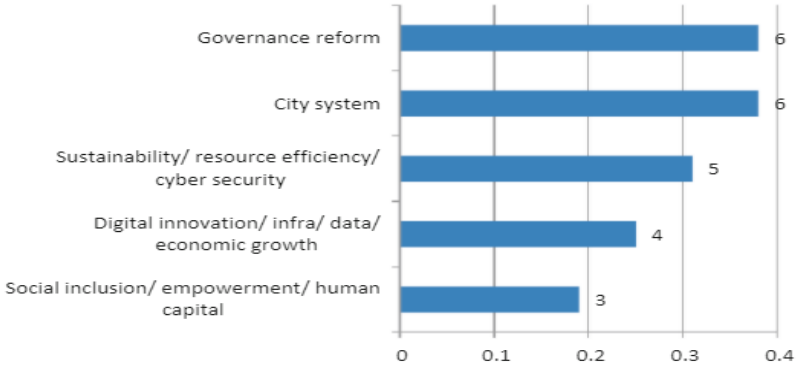


Figure 2: Occurrence of themes in the 36 strategies of Malaysia Smart City Framework[32]

Digital Economy: The Malaysian government has made a great effort to promote the digital economy, because it is the main contributor to GDP, and it will create many job opportunities. Moreover, the digital economy has played an indispensable role in linking the international market and in the Post-Covid19 era. The WKB 2030(Wawasan Kemakmuran Bersama) and the 12th Malaysia Plan are all aiming at the promotion of the digital economy.

Payment : The application of E-Payment will save people the trouble of using cash and make transactions more convenient and faster. The local government department(JKT) has developed an official portal PBTPay, trying to centralize the payment. Now, there have been 46 PBT in total in 9 states of Malaysia. At the same time, the Malaysian government promotes the application of E-payment in lower retail activities like retail shops, stalls and kiosks. By making the spending process easier and faster, the hope is to spur economic growth and tourism.

Digital Infrastructure : The Malaysian government made effort to construct the digital infrastructure. Digital infrastructure is the basis of the digital economy, which includes high-speed internet, fiber optic installation, communication infrastructure, etc. A solid digital environment is conducive to the digital economy and business activities. Malaysian Communications and Multimedia Commission has set up a its 5G network task in 2018 to explore the approach to the 5G network in Malaysia. 5G technology is crucial to industry 4.0 and the digital economy. The government encourages businesses to learn how the 5G technology works, thus they can utilize it in the future.

2.13 Peru

Peru's economy has been extraordinary over the past decade. The economy grew by an average of 6.6%. From 2000 to 2010, Peru's GDP nearly tripled, from US$53,337 billion to US $153,199 billion, which means that the GDP per capita of Peru tripled, from US$2,054 to

[32] Seng, B. L. , et al. (2020). Malaysia Smart City Framework: A Trusted Framework for Shaping Smart Malaysian Citizenship?

US$5,224. At the same time, Peru has made significant achievements in social development. The poverty rate fell from 54.1% in 2000 to 25.8% in 2012. The achievements Peru has made were mainly due to the efforts from several factors, including macroeconomic stability, improved regulatory frameworks, and trade-related performance. Besides, Peru's domestic demand has also increased dramatically, driven by increased public and private investment and increased private consumption.

Although Peru has performed well in the speed of economic development in recent years, its per capita income and productivity still lag behind other middle-income Latin American economies. Peru's economic structure is simple and undiversified, mainly dependent on its natural resources. In view of the current situation in Latin America, the Peruvian government is determined to promote sustainable economic growth by promoting the development of productivity and new sources of competitiveness in order to reduce dependency on natural resources, increase the productivity of the entire economy, and create high-quality jobs.

Given the severe economic condition, some Peruvian initiatives for smart governance and smart cities have been implemented to address economic challenges and enhance the city's innovation development. At the same time, a new proposal of guidelines for the establishment of science and technology parks guide the creation and development initiatives of Science and Technology Parks that respond to the needs of the industry.

- **Data Information**

From the government side, several governmental data portal websites have been established to share data information with all the citizens, including an Open Data Portal (http://www.datosabiertos.gob.pe/), and a Spatial data portal (http://www.geoidep.gob.pe/). Peruvian government also builds dedicated websites and systems for government usage. The National Disaster Response Operation Center (COEN – INDECI) of Peru, for instance, works as a control tower for disaster response. It collects the disaster information from other organizations, determines the disaster level, and then propagates the information. The Ministry has already been incorporating a whole database of geo-referenced plans that allow it to measure and manage solutions to the danger of disorderly growth in such a way that it is insured or crowded. In the Covid-19 emergency, the Geoplan (http://geo.vivienda.gob.pe/) is used as a strategic tool for decisions on focused isolation in critical areas, through the identification of areas with the highest sources of infection and overcrowding that determine the highest degree of contagion vulnerability.

- **Science and Technology Parks**

Under the structure of guidelines, every technology science park initiative will include six aspects:

1. A clear creation and development strategy
2. A technology transfer plan
3. The articulation of relevant actors with defined functions
4. Carrying out the activities indicated within the tentative stages of development
5. Offer indicated minimum services

6. Resources and results by phase reviewed by CONCYTEC.

- **Smart City**

Affected by the COVID-19 pandemic, the Peruvian government proposed to reformulate cities in the post-pandemic era. One welcome by-product of the crisis is that work-style reform is getting a much-needed boost because employees begin to telework, thus promoting telework among citizens. However, one of the drawbacks results from teleworking is the lack of exercise. In order to strengthen citizens' healthy habits but also protect their lives, the government put forward a concept of a compact city, which concentrates on services, increases pedestrian and non-motorized traffic.

Moving towards a smart city must begin by laying the foundations for a new vision of the city where municipalities and the Ministry of Housing, Construction and Sanitation become strategic allies. To date, Metropolitan Lima and Callao have signed two agreements with the Ministry for the generation of their new Urban Development Plan.

2.14 Skolkovo, Russia

"Skolkovo isn't a territory. Skolkovo is an ideology"

- **Introduction**

Skolkovo Innovation Center is the first and so far the only planned settlement with science-oriented specialization in Russia, created from scratch, designed for the systematic development of new technologies and their further commercialization. It is a project for the strategic development and support of Russian innovations, which creates all the conditions for the companies working in the priority directions for the Russian economy and defense capabilities: energy, nuclear technology, biomedicine, computer science, telecommunications and space technologies. Skolkovo has transformed from a wasteland near Moscow into a real innovation ecosystem that incorporates the latest achievements in urban planning, engineering infrastructure, science and technology.

The entire territory of Skolkovo was divided into five clusters, each of which specialized in a particular scientific and technological area:

- Biomedicine, which includes the Agrocluster;
- Energy Saving;
- Space and telecommunications;
- Information and computer;
- Nuclear.

These clusters have concentrated the maximum opportunities for technology development. The main city-forming objects are technopark "Skolkovo" and Skolkovo Institute of Science and Technology (Skoltech).

Technopark aims to provide companies participating in the Skolkovo project with the necessary support for the successful development of their technological assets and corporate structures by providing the services necessary for development. To optimize interaction with companies, Common Use Centers have been organized - interdisciplinary laboratories and production workshops located on the territory of the innovation city. Work continues the construction of the Moscow International Medical Cluster on the territory of the Skolkovo Technopark. The cluster is created to develop activities for the provision of medical care, improve its quality, promote the development of drugs, medical technologies, and medical devices, develop educational activities, and conduct scientific research in the field of health care based on the best world practices.

Skoltech is a research core of the ecosystem, according to the Skoltech concept, its main objectives are to attract, engage and develop a critical mass of talented people with scientific, technological and entrepreneurial competencies who associate their lives with the creation and dissemination of innovation and form a self-reproducing community through which Skolkovo and the Russian innovation ecosystem receive a flow of human resources and technological startups. And also, popularizing innovation and entrepreneurship among target audiences to promote the values and opportunities of the Skolkovo Ecosystem.

An important urban planning aspect is the preservation of the environment. To this end, it is planned to erect energy-passive and energy-active buildings: the former practically do not waste energy from external sources, while the latter able to produce more energy than they consume. In addition, it is planned to develop solar and geothermal energy. All these measures will make it possible to obtain more than 50% of the necessary energy from alternative energy.

The government deliberated the regulations on complex functions such as taxation, customs, immigration, and legal status in a short period. According to the government's decision:

- Companies cooperating with the Skolkovo received customs and tax preference;
- Technical regulation rules have been simplified;
- The organization of interaction with the authorities was simplified;
- Town-planning procedures have been eased;
- Migration procedures for highly qualified specialists invited to work in Skolkovo and their family members were eased.

In early June 2020, Dmitry Medvedev said that the Skolkovo project over the 10 years of its existence has attracted 130 billion rubles (about 180 billion in total) of private money and invested 56 billion rubles of budgetary funds.

The total number of participants in the project in 2020 is about 2,250 companies, of which 1,319 (59%) received revenue in 2019, and in 257 of them it exceeded 100 million rubles. More than 37 thousand jobs were created by startups. More than 1,300 patents were issued, of which more than 650 were issued overseas; more than 60 partner R&D centers were opened.

- **Features**

- Using the characteristics of the site and landscape as a natural framework for the city.
- Creating opportunities for productive interaction among people, knowledge, research and business institutions, which is the matrix on which innovation is based.
- Ensuring a high quality of life-based on respect for the principles of sustainable development.

2.15 Chinese Taipei

Over the past decades, the Taipei city government has used information and communication technologies (ICTs) and breakthrough new technologies to enhance its innovation process through big data and automation. As for ICTs, no matter it means setting up infrastructure to better manage energy consumption or creating free Wi-Fi zones in the city to bridge the gaps in digital access, millions of dollars are being invested by the Taipei city government to facilitate urban efficiency and sustainability.

In 2016, the Taipei city government established the Taipei Smart City Project Management Office (PMO) to create an innovation matchmaking platform that combines resources from both government and industry. It aimed to help local citizens deal with the challenges of urban life by creating new technologies, innovative applications, and data/information for life, work and entertainment. The Taipei PMO focuses mainly on five major aspects: smart transportation, smart public housing, smart healthcare, smart education, and smart payment.

The PMO believes that by acting as a "middle man" between the city government, the ICT industry and citizens, they can promote collaboration necessary to deliver innovative solutions that bring value to Taipei and its citizens. Taipei city government promotes city innovation mainly through three mechanisms: top-down, bottom-up, and citizen participation:

- **Top-down**: According to the city government's strategic action plan or the policy planning of each department, the Taipei Smart City Project Management Office works directly with government agencies to identify opportunities and propose innovative and mature solutions, such as Smart Bus Stops and 4U Smart Sharing Transportation (YouBike, U-Motor, U-EV and U-Parking).

- **Bottom-up**: The PMO proactively will engage the ICT community. Industry practitioners including MNCs, SMBs and start-ups can promote innovative solutions through a proof of concept (PoC) model. Those solutions include air box applications, self-driving car demonstration field, smart street lights and IoT innovation laboratory, etc.

- **Citizen Participation**: Citizen participation is also one of the important mechanisms for the Taipei city government to promote innovation. It is very important for PMO to create initiatives to engage citizens and better understand their needs. Through participatory budgeting projects, i-Voting system, workshops, and open data, citizens have different channels to be part of the policy decision-making process with mechanisms for input and feedback.

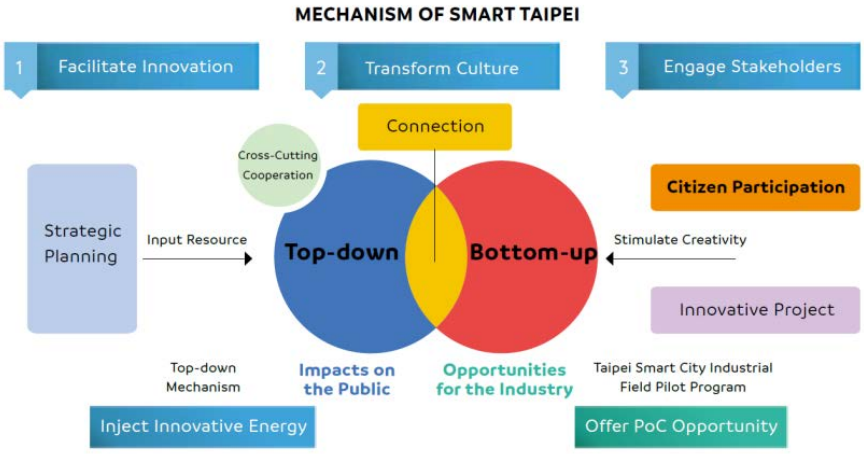


Figure 1. The Mechanism of Smart Taipei.[33]

As one of the facts, the smart transportation technology industry is currently the key industry that the PMO is focusing on. Taipei smart transportation consists of four services: YouBike, U-Motor, U-EV, and U-Parking.

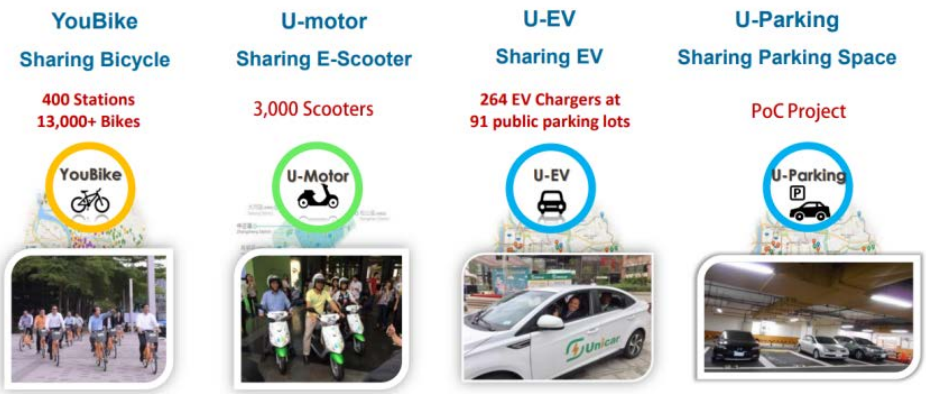


Figure 2. 4U Smart Sharing Transportation.[34]

- **YouBike**. Taipei City Government joined forces with a local bike company to develop the bike-sharing system. YouBike had 400 rental stations with over 13,000 bike services in 2019. Citizens can find a Youbike station within 10 minutes walking distance. Anyone needing YouBike rental and parking services can download the APP and find stations that provide 24-hour services, seven days a week.

- **U-Motor**. Citizens can rent electric mopeds (Gogoro) to travel around Taipei at any time via mobile app, without the need for manual procedures or returning it at a specific station. The

[33] Taipei Smart City Project Management Office. (2020). *Smart Taipei.* [PDF. file]. Available at: https://163.29.36.132/docs/en/Brochure.pdf.
[34] Taipei Smart City Project Management Office. (2020). *Smart Taipei: government as a platform city as a living lab.* [PDF. file]. Available at: https://smartcity.taipei/uploads/download/download/2/en_1605681140_Presentation_en.pdf.

backend operation team working together with the city government monitors the status of fleet utilization at any time and check vehicle battery conditions in real-time. At present, 2,000 electric scooters have provided rental services in 11 administrative districts of the city.

- **U-EV**. In Taipei, 200 electric vehicles (EV) charging stations have been installed in 80 public parking lots to create an electric-car friendly city environment. Citizens can directly use the smartphone APP to hire a vehicle for one-way rental service. The existing electric vehicles can travel as far as 250 kilometers without recharging. In the future, the Taipei city government will also work with its adjacent cities to jointly create an electric-car friendly environment and expand the 4U capital living circle.

- **U-Parking**. In 2018, U-Parking smart parking service was added to the previous 3U project to address the frequent parking shortages. The objective of U-Parking is to open up the available idle time of parking spaces for everyone to use, including parking areas of schools, government agencies and private parking spaces.

2.16 The United States

- **Innovation Ecosystem**

Innovation Ecosystem, as described by American experts on the Nanjing Event, is formed by the resources, institutions, infrastructure, and people that sustain the development of new ideas into products, processes, and services. A healthy and rich innovation ecosystem can accelerate economic growth in regions and cities. At the regional or city level, these components support clusters of economic activity around research institutions that provide technical expertise and a range of business-related inventions. The reason why companies are clustered together is that proximity promotes positive spill-over effects, thereby promoting productivity growth and creating cost advantages. In these clusters, innovation is a key source of competitive advantage.

Traditionally, the Three Triple Helix of industry, academia (the university), and government are considered to give life to innovation ecosystems as they are bricks and stones to build an innovation ecosystem. The Three Triple Helix, also called the “triple helix model of innovation”, aims to foster economic and social development. Each sector is represented by a circle (helix) and these circles are overlapping to show their interactions. Three components of the model have their own objectives and roles: universities engage in basic research; the industry produces solid commercial goods; the government sector formulates laws and regulations. However, they can evolve to adapt some features from each other to help facilitate economic growth.

- **Case Study**

For a long time, the United States has led the world in developing cutting-edge knowledge and technology. A better innovation ecosystem with an active private sector, federal and local government support, and leading universities have kept America at the innovation frontier for decades. Indeed, for developed economies like America, innovation has always been the

source of economic growth. As the United States continues to increase its attention and investment in innovation, innovative areas continue to emerge in the metropolitan areas of the United States. Based on the speeches made by the US representatives on the Nanjing Event, the Project Overseer continued to supplement the actual cases of innovation cities in the United States according to his research and observation. These innovation areas include innovation medical centres, innovation clusters, and innovation parks.

1. Silicon Valley

Silicon Valley is the innovative technology centre in the United States. One of the main features of Silicon Valley is that it is backed by top universities nearby, such as Stanford University and the University of California, Berkeley. These universities have played a great role in driving local economic development in the process of innovation practice. Especially in the transformation of innovation, the combination of open innovation and venture capital has produced a large number of scientific and technological innovation outcomes. In addition, it is based on large companies such as Google, Facebook, HP, Intel, Apple, etc., so that the industry, the academia and governments could work together.

2. Texas Medical Centre (TMC)

The Texas Medical Centre is the largest medical complex in the world with over 60 medical institutions, in which its Management Committee plays an important role. In this process, TMC has organized mechanism activities such as TMCx, and standardized infrastructure construction and layout, so that these medical institutions can have a better division of labour and cooperation. Such an efficient management organization plays an important role in building the city's innovation engine.

3. Cleveland Clinic

Cleveland Clinic is a non-profit multi-specialty academic medical centre. The annual Medical Innovation Summit held by Cleveland Clinic is an influential innovation summit in the global medical sector. Through the summit, Cleveland Clinic's influence has become an industrial concentration in the world. In addition to Cleveland Clinic, the University of Texas Southern Medical Centre also plays an equally important role in regional innovation.

4. North Carolina's Research Triangle Park

North Carolina’s Research Triangle Park (RTP), founded in 1959, is the earliest high-tech research park in the United States, which is jointly founded by the state government, local enterprises and universities. RTP has developed into one of three major scientific research centres in the United States, which are as famous as Silicon Valley and Texas Research Park so that it has made great contributions to the leading position of American STI development in the world.

5. Smart Highway System in Atlanta, Georgia

In Atlanta, Georgia, a smart, high-tech, and sustainable highway has been built. The smarter highway system that enables advanced mobility, connected vehicles and autonomous vehicles will help to reduce transportation crashes, thus helping to reduce transportation fatalities. An

18-mile segment of Interstate 85 has been outfitted with the physical infrastructure and the digital infrastructure, so that self-driving vehicles at 70 miles per hour can be accommodated. Moreover, a data platform in the cloud has been created for ingesting or hearing the car-to-car communications between connected cars. That physical infrastructure on the roadsides can hear the data sets broadcast by connected cars.

3. Insights

Thanks to delegates who shared such cases at the first event of the Project, the Project Team could get an insight into the development of innovation cities in the Asia-Pacific region. It requires a lot more cases and experiences to output accomplishment to help innovation city development in the APEC region, but such sharing and this report could constitute a solid first step for connectivity of relevant knowledge for all developed and developing economies to build innovation cities more effectively.

Part III Conclusions and Policy Recommendations

It is obvious that innovation city is one of the major aspects that many member economies of the APEC region are focusing on. With so many examples, we believe that innovation city could be an effective driver to economic growth for its driving effort to infrastructure construction, industry cluster development which leads to a favorable environment for MSMEs development, etc. While making more and more effort on innovation city development, knowledge sharing as well as connectivity in talent, institutions between member economies would be necessary so what's learned from successful cases of innovation cities could benefit more people not only in the Asia-Pacific region, but even the entire world.

Considering stronger and stronger climate change influence on human society, we believe that innovation city development may also involve resilience to climate influence into city planning. It has been proven by many researchers that living quality is one of the critical elements for the attraction of innovation cities to talents, academic and R&D entities as well as enterprises. With a better living environment and quality guaranteed by stronger resilience to extreme weather and even natural disaster, innovation cities would be able to maintain attraction towards innovation resources and human resources, which would benefit the further development of the city in return.

According to the Triple Helix Theory that was introduced in the previous phases, government, industry and academics are running important roles for an ecosystem of science, technology and innovation development. In this very concept of innovation city, it seems that this concept is still working as a suitable method, although, there are some further key elements which are supposed to be added into its graph.

First of all, the governmental institutions need to be clearer about how the process of innovation operates, include who are supplying necessary resources (mostly are advanced technologies) of the achievements, and who would be the potential demanders. Indeed, the government should always give the required support to this process, to make sure that the innovation performances are led to society and economic growth.

What is more, after the suppliers and demanders have been involved in the system, all those key forces should perform more actively to establish efficient value chains and platforms, so that those necessary resources will be better integrated and matched to each other. For instance, the government should know how to provide promotive policies on both sides of technology commercialization, as well as establish a system for innovation like S&T parks and areas. More and more new approaches are supposed to be accepted as tools, e.g., construction of advanced S&T devices, new types of S&T entities, and influential flagship programs.

Overall, it is a kind of new viewpoint based on that classical theory, and the government is expected to perform as an invisible hand on the distribution of resources, when providing political materials for those participants.

In order to further operate the Project's work and benefit innovation city development in the APEC region, the team is supposed to keep applying for the next round of APEC funding projects under the working group of Policy Partnership of Science, Technology and Innovation (PPSTI), after initial study of innovation city assessment systems and cases, the next stage work could be these tasks below:

1. To develop an official assessment system for innovation cities in the APEC region;
2. To collect and publish typical cases of innovation cities in the APEC region regularly;
3. To establish a network for AEPC innovation city cooperation, as well as a proven ecosystem.

Considering that innovation city is a concept about driving city development with innovation ecosystem, science and technology industrialization, Nanjing event delivered an achievement document (APEC Innovation City Nanjing Initiative), which was based on discussions on the Forum, and all participating delegates proposed the initiatives as the followings:

1. Basic Consensus

1.1. We acknowledge that the quality development of cities and city clusters is of great importance to regional economic growth. Science and technology innovation is one of the important driving forces for the development of cities and city clusters. It will promote cooperation between public sectors, industry clusters and carriers, universities and scientific research institutions related to cross-border science and technology innovation cooperation, develop innovation cities, and make a contribution to co-development of APEC economies;

1.2. We acknowledge that technology fields, critical concepts and modes including digital economy, smart city, green and sustainable development, urban infrastructure construction that relevant to construction and development of innovation cities are important opportunities for both developing and developed member economies in the APEC region. It would greatly benefit the development and inclusive growth of APEC member economies to lay more emphasis on common development and close cooperation in such fields;

1.3. We acknowledge that integrated regional development and Connectivity Blueprint, as one of the major work priorities of APEC, are important philosophies for economic growth and co-development of the APEC region. Physical connectivity, institutional connectivity, people-to-people connectivity and other core concepts that APEC member economies emphasize could effectively facilitate utilization of advanced technologies, talent, industry, market and other advantage resources in open innovation cooperation between cities;

1.4. We acknowledge that facing the complicated situation after the COVID-19 pandemic, APEC member economies should work together to handle challenges not only in policy and public health, but also in restart progress for the robust and inclusive development

target to shared prosperity according to APEC Vision Post -2020, rely on the driving force of innovation. The cities in the APEC region as the crucial entities constructed to the holistic growth are taking responsibility for local development, hence the coherence and coordination for the promotion of innovation city development and cooperation. They should be emphasized with their wider range contents of science and technology innovation and entrepreneurship development, as well as the joint development of innovation ecosystem with close cooperation over the whole supply chain;

2. Goals

2.1. We propose to develop a cooperation channel between government, private sector and universities with triple helix cooperation between government, enterprises and universities, thus building science and technology promotion policies, industry innovation modes and standard science and technology accomplishment transformation process that orient to market potential and industrialization, and promote dialogue between the private sector and public sector, create a new environment, and structural reform in the APEC region;

2.2. We propose to work closely with the academic and private sector, including ABAC mechanism of APEC, to promote innovation city and city cluster in the APEC region, accelerate development and building of innovation ecosystem constituted with industry innovation region, industry parks and incubators, accelerators and other science and technology innovation carriers, and promote cities to realize quality development and economic growth by undertaking practice and concrete areas;

2.3. We propose to promote innovation cities in the APEC region to pay attention to environment protection, accelerate the development of green and sustainable development technologies and concepts including clean energy, climate resilience, environment-friendly and biological infrastructures, and practice sustainable development philosophy by adopting comprehensive solution for the issue of co-development of cities, economy and environment;

2.4. We propose to promote smart city development concepts and relevant core technologies in the APEC region, explore application solution of the new generation of information technology in city innovation development, in-depth integrate informatization, industrialization and urbanization performance with the livelihood of residents, and accelerate the construction of corresponding infrastructures;

2.5. Adhering to APEC Internet and Digital Economy Roadmap, we propose to seize the development timing of this digital age, promote traditional industries and urban construction to transfer to digitalization mode, offer favorable innovation and entrepreneurship to youth, female and MSMEs based on innovation city, and thus making contribute to the realization of leapfrog development and bridging the digital gap in the APEC region;

2.6. We propose to continuously focus on key elements for science and technology innovation in the process of city development, including science and technology R&D input, high-end talent raising and exchange, knowledge commercialization, IP protection, development and integration of finance and science and technology service industries, thus guaranteeing efficient utilization of advantages resources of APEC member economies;

2.7. We propose to motivate the establishment of exchange and cooperation mechanism between innovation cities in the APEC region; encourage city clusters, innovation cities, reputational experts and think tanks to participate establishment of such mechanism, and organize regular academic workshops, talent raising and dialogue, roadshow and matchmaking and other forms of exchange activities, to create a favorable environment for innovation capacity building of cities in the APEC region;

2.8. In consideration of innovation city construction status in the APEC region, we propose, adopting city as a unit, develop assessment indicators, assessment methods and assessment system to figure out relatively clear guidance and work direction for the development of innovation cities in the APEC region, promote spread of advantage innovation city concepts and critical data, and thus summarizing and promoting latest development accomplishment;

3. Action Plans

3.1. To collect demonstrative innovation city cases in the APEC region by forms of city cluster, innovation city of different scale, special region, industry parks and industry innovation carriers, and cutting-edge technologies; analyze and categorize cases; and thus, further serving as a reference for innovation city development in the APEC region;

3.2. To facilitate the institutional network among the innovation cities in the APEC region for the continuous increasing cases of the best policy building and practices, and enhance possible coherence and cooperation between cities based on the better mutual understanding by learning from the systemic indicators and the relevant important information, as well as strengthen the implementation of referring to the recommended practices.

3.3. To engage the joint studies and researches for exploring the methodologies of best cases with the value of sharing, to advance undertaking of practical and concrete areas of quality infrastructure encouraging the adoption of enabling innovative technologies and services, particularly in digital infrastructure, including the internet and information and communication technology network to accelerate opportunity for business MSMEs and people across the region.

3.4. Start early-stage works for establishment of APEC innovation city assessment system including research, expert discussion and system development, work out a draft for discussion, and organize exchange and discussion within the APEC region to collect

opinions and suggestions, and then work on official endorsement and establishment by PPSTI or other work mechanisms under APEC framework, and engage a workable ranking to be invented for a better reference to APEC member economies.