The Formation of the Greater Bay Area in China as a Regional Innovation System

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1 Introduction

The objective of this research is to analyze the creation process of Regional Innovation Systems (RISs) clusters in the People's Republic of China (PRC), in particular the case of Shenzhen Special Economic Zone (SEZ), which became the center of the Pearl River Delta Development Region (PRDR) (also called Greater Delta), which in turn was transformed into the Greater Bay Area (GBA) including Hong Kong Special Administrative Region (SAR) and Macao SAR. The GBA is one of many RISs of the PRC. It is part of the national and global innovation systems, which include aspects of the Belt and Road Initiative (since 2013), especially the 21st Century Maritime Silk Road Initiative, as well as organizations already established and to be established based on these initiatives.

The formation of RIS in China itself is both a current phenomenon and a trend, and not yet fully established in the course of global economic and social uncertainty. Thus, this research aims to systematize different data and information for further study of the phenomenon of RIS and clusters of post-industrial cities as parts of national and global innovation systems.

So, we will study and go in depth into the relationship between the state "Reform and Opening-up" policy that began in 1979, the PRC National Innovation System (NIS) strategy, and RIS development features of the GBA, with the center in Shenzhen. Shenzhen SEZ is one of the most developed, productive, and competitive regions of PRC. In 2020 was named the most innovative city, the city of realization of the "Chinese dream", the demonstration zone of the "Reform and Opening-up" policy, and the "National Innovative Strategy" of the PRC (Du, 2020).

All actions aimed at the creation and development of a NIS, and specifically the RIS in the Pearl River Delta region, are based on strategic planning. This, in turn, relies on a scientific approach, several theoretical concepts, and ideas, as well as the close cooperation of all actors in the quintuple helix of interactions – government, industry, business, scientific institutions, society, and ecological balance (Carayannis & Campbell, 2010; Thorsten, 2011; Carayannis et al, 2012; Baccarne et al, 2016).

Foresight and strategic planning have historically played an important role in China and have gone through a series of stages of development (Xu, 2008). A strategy is the definition of a system of actions aimed at achieving the main goals of management in the long-term future. It is a choice of a path that leads from the present to the future. The PRC strategies coincided with the United Nations (UN) implementation of the global principle of sustainable development and in general, the construction of Shenzhen and the reform of the whole Pearl River Delta region took place under the aegis

of transforming outdated principles and using new criteria and strategies for socio-economic development based on the theories of the sectoral economy development, knowledge economy, convergence and the ideas of the digital economy and sustainable, green urbanism (Pow & Neo, 2015; Ng, 2019).

The starting point of strategic planning is the current state of affairs, and its socio-economic opportunities. Strategic planning enables conscious and enterprising planning of the future, as well as acting contextually with individual events that have occurred at some point in time. Quantitative planning dominated until the 1980s. Later, with the implementation of the ″Reforms and Opening up″ policy, a new orientation of the public forecasting and planning system began. The social sphere gradually received more attention. In the 1990s, a new form of planning – long-term indicative planning, started to take hold. In the PRC there were also four levels of planning – national, sectoral, territorial, and enterprise planning, and they all are interlinked. Gradually, regional and sectoral innovative strategy planning has become increasingly important (Xu, 2008).

Strategic planning in modern China is used for the creation of international integration initiatives and the development of innovation. International integration includes the BRICS[1], The Belt and Road Initiative[2], the 21st Century Maritime Silk Road[3], the RCEP[4]; and the development of innovation includes ″Made in China 2025″[5] and the Digital Economy strategy[6] to transform China into a global innovation leader, and to establish a space force by the mid-21st century. These initiatives and the development of innovation have the objective to transform China into a ″Harmonious and Environmentally Friendly National Innovative System″ or ″Harmonious World of the Future″ by 2049 (Coco, Orazio, 2020).

An important feature of the ″Reform and Opening-up″policy (since 1978), even at the initial stage, was its innovation and inclusiveness, the reliance on advanced global technology and science, which largely determined its further success. Initially, this policy initiated by Deng Xiaoping was a political, economic, scientific, and social experiment. Its implementation took place in

[1]Acronym of Brazil, Russia, India, China, South Africa, an organization and forum founded in 2006.

[2]The president Xi Jinping proposed this Initiative in 2013 as a way to promote the globalization of China focused on infrastructure development, and investment.

[3]It is part of the ″Belt and Road Initiative″ referring to sea routes through Southeast Asia to South Asia, the Middle East and Africa.

[4]Acronym of Regional Comprehensive Economic Partnership. A free trade agreement of 15 Asia-Pacific nations signed in 2020.

[5]National strategic plan approved in 2015 to lead key areas in technology.

[6]I.e., the 14th Five-Year Plan perio d (2021–2025), include a Plan on Digital Economy Development.

selected territories (Special Economic Zones or SEZs). Guangdong Province, specifically the border region to the British and Portuguese colonies of Hong Kong and Macao, the Pearl River Delta, was of particular importance in the initial stage of the reform.

At the Hong Kong border, it was decided to build a special economic-industrial zone named after a small border river "Shenzhen". This SEZ, with its special laws and regulations on investment, joint ventures and trade, was built and developed rapidly. Literally within a few decades grew from a frontier settlement to a modern metropolis, the innovative center of the region, and an emblem of the new China.

The phenomenon of Shenzhen and the success of China's "Reform and Opening-up" policy has attracted and will continue to attract the interest of the international academic community and researchers belonging to different fields of knowledge: East Asian Studies, political scientists, economists, sociologists, historians, and international relations specialists.

The novelty of this study lies not only in the fact that it examines Shenzhen and the Greater Bay Project as a result of the practical application of the theory of national and regional innovation systems and new digital economy principles of intelligent green urbanism and smart cities ecosystem, but also because it presents a multi-dimensional analysis of the factors contributing to the creation and development of the region in question.

Therefore, it is necessary to consider the development of Shenzhen, the Pearl River Delta region, and further the Great Bay Area in a time frame: since the start of the Reform and Openness policy in 1979 until 2021, may be divided in two stages. The first one, from 1979 to 2013, is characterized by the industrial development and construction of the future conglomeration according to the triple helix principle of cooperation between government, industry, and science, and the increase of production capacity (Cai & Etzkowitz, 2020). This stage is characterized by the implementation of the policy of "Reform and Opening-up" and the principle of "Four Modernizations" – agricultural, industrial, military and scientific. In particular, the agrarian reform and de-collectivization of the countryside, large-scale industrialization, regional policy of establishing SEZs, and the development of China's "Opening up" cooperation and relations with Hong Kong on the principle of "One country, two systems".

The second stage began in 2013 and is still going on. It can also be divided into several phases: the first until the submission of the GBA project itself in 2017, which is the focus of the study; the second after 2017 up to the current moment. It includes the period when China was isolated by the COVID-19 Pandemic (January 2020 to December 2022). What concerns the development of smart cities and innovation systems in the region of Guang-

dong Province and the PRC as a whole is an event series of the present time and, accordingly, the research and narration of the ongoing processes is stylistically a report supported by data from official and independent sources, expert opinions and to a large extent personal observations and comparisons aka "field studies".

This second stage is characterized by the strengthening of economic innovation and digitization and China's development as a NIS according to the principles of the quadruple and quintuple helix model. It coincided with the large-scale development of domestic and global infrastructure projects, besides the development of information technology and international cooperation projects. During the first stage (1979–2013), China accumulated and adjusted global technology and built up its economic basis. And since 2013, it has been moving towards creating and exporting its own unique technologies and know-how, acting as a global hub for scientific thought and innovation. All of China's current plans and strategies include the idea of a balanced and harmonious world of the future, a synergistic society based on the principle of inclusion and maintenance of ecological balance.

The scope of this research includes perspectives and approaches of innovative economy, political science, political geography, urban and environmental studies, sociology, international relations, etc. In addition to being interdisciplinary, the study is based on a wide range of tools and methodologies of the humanities disciplines. The sources for this research are mainly government publications of development plans and construction projects, as well as statistical data provided by the regional and national governments of the PRC, but also by private think tanks, consulting companies, and so on. The specificity of the data on PRC strategic plans are characterized by a certain level of secrecy and low transparency of the information. There is a large scattering of data in the specific works of the researchers. The author of this study also obtained information on infrastructure development and innovation from museums and centers devoted to reform and urbanism that have been recently opened in the Pearl River Delta cities. The data are complemented with the consultation of media news and blogs. And there is also a literature review of research and academic works on the different analyzed issues.

The system approach in this research consists of using knowledge from different areas of scientific knowledge and scientific disciplines, their synthesis, and adaptation to the subject of research – identifying the nature and interaction of economic, socio-historical, national, and cultural conditions serving to the formation of the region under study. The application of the system approach provides a circulation of methods of cognition of reality, a synergy of different scientific fields.

The regional innovation system is a complex structure that can be evaluated using different assessment criteria in terms of innovativeness, economic development, global involvement, synergy of integration or disintegration of its components.

On the one hand, some China's regions can be considered as innovative systems, namely as cluster or regional innovative systems, i.e. relatively integrated territories formed in close connection and interaction of nature, society, science, industry, and the state. The integration of the system is determined by direct, reverse and transformed links developing between subsystems. The relationships in such systems are vertical, i.e. between components of one part, such as industry, the state, and infrastructure; and of horizontal nature – i.e. interconnections between nature and society.

On the other hand, China's regions are part of "large innovative systems" – the global innovative economic system, the international organizations that can be simultaneously regarded as subsystems. Thus, they are autonomous to a certain extent, and they have their own particular geographical, economic, social, cultural, and political characteristics.

The Regional Innovation Systems (RIS) and Industrial innovation clusters act as system-forming elements and areas of high concentration of technological activity, or "growth poles". Regional clusters now play a leading role in the sectoral structure of the national and regional economy of the PRC. At the level of regional clusters, there is an integration of science, the education system, and regional production (Asheim et al., 2011).

This thesis is divided in eight chapters apart from the introduction and conclusion. Each chapter focused on one aspect of the development of the Pearl River Delta (Greater Bay Area) under the paradigm of the innovation economy and according to the PRC government's strategic planning.

In the first chapter are reviewed the main concepts underpinning the transformation processes in the PRC and the Pearl River Delta region. We discuss the relatively new ideas of knowledge economy development, national and regional innovation systems, and the genesis of the Digital Economy and Green and Smart Urbanism concepts.

The second chapter analyzes the Reform and Opening-up policy from its inception in 1978. This policy led to massive industrialization, urbanization, and "opening up" of the PRC to international capitalism and foreign investment, and the emergence of widely used terms as the "Chinese Economic Miracle", "China as world factory", or the coined "Socialism with Chinese Characteristics", among others. This phase of China's development has been the subject of many studies on Deng Xiaoping's role as its architect, and Guangdong province as the flagship and experimental springboard of the new policy (Vogel, 2011). The section focused also in the analysis of the

agrarian reform of the PRC, in particular the emergence of the phenomenon of the ″Ten Thousand Yuan Yard″ characterized by the introduction of agricultural and family cooperatives and the development of private business in the Chinese countryside, which enabled ″Clothing and Feeding″ the rural population. The development of industrialization in connection with the liberalization of the economy and the particularities of Chinese foreign policy are also examined.

The third chapter focuses on the foundation of experimental Special Economic Zones (SEZ), and the development of this strategic planning principle over the 40 years from 1980 to 2021. The establishment of various industrial and commercial zones with special economic regulation policies led to the concentration of enterprises with foreign investment, which made China a global leader in production, and gave impetus to the formation of cities and the development of science & technology, and innovation. China's initial regional policy was characterized by the development of the Triple Helix Model of the innovation economy, also referred to as ″Strategic Coupling″ , an alliance between the state and private business.

Fourth chapter deals with the return of Hong Kong to PRC jurisdiction and its impact on the economic, integration, and innovative development of the Pearl River Delta region. The process of establishing the Hong Kong and Macao Special Administrative Regions (SAR) of the PRC took place in the context of continuous confrontation of the already established different political regimes. Meanwhile, the development of integration, as well as direct and indirect investment through the territory of Hong Kong led to economic growth in both Hong Kong and China.

The fifth chapter analyzes Shenzhen's evolution, rapid growth, and urbanization. In 2020, in the year of its fortieth anniversary as SEZ, Shenzhen was named a ″demonstration city″ for Reform and Opening-up policy and the heart of Chinese innovation. But just 40 years ago it was a place of fields and swamps with small towns and villages. Shenzhen is remarkable not only for the speed of its construction, but also for the fact that it was free to choose the most topical and innovative development strategies, eventually becoming a focal point not only for high-tech but also for green, sustainable urbanism.

Innovative infrastructure development, and the ″knowledge-based digital economy″ principles implementation in modern China is the subject of the sixth chapter. The creation and rapid development of the GBA regional innovative system has been based on a SEZ under the conditions of continuous construction, urbanization, and industrial growth. This section also discusses the transport and infrastructure integration of the Pearl River Delta and Greater Bay Area under the base of the Digital Economy. The devel-

opment of innovative transport infrastructure, high-speed rail network, and digital transport innovations. It is the development of infrastructure and information society that allows to move from the triple helix model to the quadruple helix and quintuple helix models, as it includes the society in the process of management and development of the economy (Baccarne et al, 2016; Carayannis et al, 2012).

The seventh chapter analyzed the development of intelligent cities and green urbanism in China. These principles are inextricably linked with the digital economy and the synergy between the state, industry, science society, and the environment. Only the development of green urbanism can create a balance between the development of technology and the preservation of environmental sustainability.

The eighth chapter of this research focuses on the uncertainty factors faced by the PRC and in particular by the GBA region in implementing Reform and Opening-up policies and regional and innovation systems strategies. This chapter deals with the economic imbalances, China–Us trade conflict, movements and protests in Hong Kong, as well as the challenges facing society in the spread of Pandemics COVID-19.

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2 The Theoretical Framework

The formation of the Greater Bay Area is systemic in nature and illustrates in practice various economic and urban theories and concepts. The region's development is based on an innovative knowledge economy that includes the concepts of regional innovation system and national innovation system. Moreover, it promotes the coexistence on a vast territory of social and economic formations in the form of three-dimensional, four-dimensional, and later five-dimensional innovation helix – science-industry-government-society-environment interactions within a knowledge economy. Several urban concepts have been implemented in the construction of the Area as a commonwealth of smart cities organized on the principles of green urbanism, sustainable development, and modern regulation of the whole complex urban system.

2.1 The Complex Nature of the Mixed Economy of Development and Innovation

China is now one of the strongest countries in terms of economy, politics, and industrial governance. It has a large population and limited resources of economic nature. However, this does not prevent the state from being a leader in certain areas of economic activity in the face of global competition. China's economy is not homogeneous. It is a mixed economy based on a variety of economic approaches. The Chinese mixed economy model is a complex and evolving system of economic relations, built under the state ideology of socialism.

The theory of development economics focuses on improving the financial, economic, and social conditions in developing countries. Development economics looks at factors such as human capital, health, education, working conditions, domestic and international policies, and market conditions. The application of this theory aims to improve living conditions in the world's poorest countries. Development economics seeks to understand and shape micro and macroeconomic policies to lift poor countries out of poverty (Ang, 2016; Cable, 2017).

Development economics studies the transformation of developing countries into prosperous countries, strategies for transforming the developing economy, the extent to which rapid population growth helps or hinders development, the structural transformation of the economy, and the role of human capital, education, and health in societal development. It is also based on research on international trade, globalization, sustainable development, the environment, and the effects of uncertainties such as epidemics

and disasters on economic and human development. Prominent development economists include Jeffrey Sachs, Hernando de Soto Polar, and Nobel Prize winners Simon Kuznets, Amartya Sen, and Joseph Stiglitz.

The category of development, as a general concept, covers a wide range of problems not only in economics but also in the social, institutional, and political transformation of countries and regions. A comprehensive study of the category of development is legitimately conducted under the methodology of the systems paradigm, the conceptual basis of which was developed by János Kornai (Ellman, 2021), who considers that the differences between the paths of national economic development should be sought in the field of the political system and cultural traditions.

Thus, cultural characteristics and national values play an important role in the process of economic modernization. The diversity of conditions, resources, and factors of development has led to the development of new approaches in economic theory. The neoclassical economic theory began to incorporate conceptual conclusions about human capital theory into its models. In the Solow model (1956) and its further modifications, human capital acts as an endogenous factor of economic growth. Human capital is a measure of an individual's embodied potential to generate income (Solow, 1956; Boon et al., 2018).

Human capital includes innate abilities and talents as well as education and acquired qualifications. It is the present value of the discounted value of the additional productivity of people with experience and qualifications over and above that of unskilled labor. Human capital can be acquired through special training or on-the-job training. Like capital in the form of tangible assets, it is subject to aging due to changes in technology or demand. The special role of human capital in sources of development can be explained by many objective assumptions: Human capital comprises a set of productive qualities expressed in acquired knowledge, and skills, and is used to produce economic goods (Boon et al., 2018).

There are various forms of investment in people: education, health care, the set of costs necessary to prepare a person for productive activities, etc. The formation of human capital depends both on the person himself and on the significant costs invested by society. Investment in human capital provides its owner and society as a whole with higher returns. Consequently, human capital is regarded as a stock that can be accumulated and is capable of generating higher returns in the future.

Human resources determine the content and stages of socio-economic development. Thus, countries that develop people's knowledge and abilities create the potential for high economic growth. The basic factors of production – capital and land, remain passive factors, while people with general

and professional knowledge are the most active growth factors. The ideas of development economics thus overlap with the ideas of innovation economics, that industrial economies based on natural resources are being replaced by economies based on knowledge and innovation (Boon et al., 2018; Wright, 2021).

Innovation and the development of science and technology were the main driving forces behind the ″Reforms and Opening up″ policy initially designed to ″Clothe and Feed″ China's billion population. The PRC Strategic Economic Planning drew on the latest achievements in science and technology as well as regional experiments in implementing the latest economic concepts, such as Sectoral Economic Development ideas, the Knowledge Economy, National, and Regional Innovation Systems, the principles of Integral Regionalization, and Globalization and the construction of a Post-industrial Digital Platform Smart Ecosystem – ″the Harmonious World of the Future″ or ″Metaverse Civilization″ .

The innovative economic and social experiments of the PRC were implemented in the most developed coastal provinces, especially in the territories bordering Hong Kong and Macao – the colonial enclaves of the United Kingdom and Portugal that were steadily preparing themselves for returning to China's jurisdiction since 1984. Guangdong Province, with its Pearl River Delta region (PRDR), was chosen as the site for technology development and experimentation in building integrated urban industrial clusters, in which knowledge-intensive fields of production and innovation were systematically developed. By the 40th anniversary of the ″Reform and Opening-up″ policy (2020), the PRDR, consisting of nine ″smart cities″ actively integrated into a single digital ecosystem and centered on the virtually clearing ground of Shenzhen ″net-city″ , has become one of the most advanced innovation agglomerations in the world. Shenzhen has been named the ″Silicon Valley″ of PRC and chosen as the demonstration city for innovation development in the reform and opening up as well as the future Greater Bay region (GBA) to integrate the PRDR with Hong Kong and Macao into a unified Regional Innovation System (RIS) or ″Smart-cities Cluster″ .

In this research, we examine which components have shaped the development of the GBA's RIS, considering this phenomenon from different perspectives – historical, economic, urban and innovative. To analyze the significance of this agglomeration on two levels - regional and global and explore the PRC's role as a one of the leaders in global initiatives.

The fundamental issue behind the development of the modern Regional Innovation System (RIS) and National Innovation Systems (NIS) of smart cities is to maintain a balance between economy and ecology. Innovative economy and urbanization are primarily aimed at harmonization of human

and environmental actions – economy digitalization, green urbanism, applying the "Quintuple Helix Model" of the knowledge economy, analysis of an embodiment of these concepts in the PRDR is the main aim of this study.

Theoretical foundations for regional planning and modeling of the PRDR are enshrined in official documents of the PRC and Guangdong Province governments (Table 1).

Table 1: Official Plans for the PRD Transformation

Name	Year Published
Urban system planning in the Pearl River Delta of Guangdong province (1991–2010)	1990
Pearl River Delta Economic Region Urban Cluster Plan	1995
PRD Urban Cluster Coordinated Development Plan (2004–2020)	2003
The National Medium- and Long-Term Program for Science and Technology Development (2006–2020)	2006
Outline of the Plan for the Reform and Development of the PRD (2008–2020)	2008
Outline Development Plan for the Guangdong–Hong Kong–Macao Greater Bay Area (2019–2035)	2018

Source: Author based on various publications.

The process of forming an industrialized and urbanized cluster of nine cities in the Pearl River Delta as well as the rapid construction of the modern cities of Shenzhen and Zhuhai (SEZs) on the borders of Hong Kong and Macao is complex and multilayered. The search for sustainable economic and territorial development for a progressive society, and economic digitization is one of the priority tasks. Strategies for urban, macro and micro-regional development in many countries around the world are elaborated by state, regional, and local authorities, including the involvement of experts, the scientific community, and society.

The study of China's industrialization and urbanization in the course of the "Reform and Opening-up" policy, as well as the research of the modern NIS and RIS, faces several challenges. These include the wide range of issues associated with the processes described and the volatile nature of the data, and the lack of conceptual unity in the global scientific community in judgments, assessments, and descriptions of processes occurring in connection with the rapid spread of information technology. At present, the speed of digitalization and China's transformation are so fast that data are becoming

outdated very quickly. However, the main theoretical concepts related to the issues of this research are roughly divided into socio-economic and urban ones (Table 3)

Table 3: Theoretical concepts related to the innovative development of the PRC RIS

Time	Socio-economic		Urban	
1979-2012	Three Sector Model	Innovative Economy	URB-systems	Eco-urbanism
	Economy Integration	Triple Helix Innovation Model	Sustainable Development	
2013-2035	NIS & RIS	Quintuple Helix Model	Green Urbanism	
	The Society of Small Prosperity 小康 Xiaokang (2021)		Intelligent Urbanism	
	Digital Economy	Society 5.0	Smart-Cities	
2035-2049	Transforming to the NIS, Creation of the RIS (The Greater Bay Area, Bohai Economic Rim, Hangzhou Bay)			
	"The Society of Datong 大同" – "Harmonious World of the Future"			

Source: Author based on several sources.

2.2 New Economic Strategies

In general, the main PRC's strategies of building the "Harmonious World of the Future" are based on a wide range of economic theories and ideas, of which several underlying principles can be distinguished.

Firstly, it incorporates many rational ideas from previous eras, and the basic criterion for any social and economic development concept applied in the PRC is the principle of "Three Values" i.e. the benefits of any theory for economic development, the aggregate strength of the state, and the improvement of people's living standard (Zheng, 2017; Atkinson, 2021).

Secondly, instead of the Marxist-Leninist slogan "Take up the class struggle as the decisive link in the work", the main task facing the "Harmonious

World of the Future" is the economic development and the building of a National Innovation System (NIS) (Chen & Guan, 2011; Yu et al., 2014; Prodi et al., 2016).

Thirdly, conclusions about China's future development strategies are not drawn from pre-existing formulas and ideas, but from a systematic analysis of changing and still transforming practices both in China itself and around the world.

Undoubtedly, the concept of a "Harmonious World of the Future" in the PRC is based on the idea of building "Communism" as a certain ideal social structure and stage of social development, which follows the stage of building "Developed Socialism". However, the economic theory of socialism, in the course of theoretical and practical search over the years of reform, has undergone significant changes in the previous conceptions of "Classical Socialism" (Zheng, 2017; Tanjangco et al., 2020). "Socialism with Chinese Specificity" differs in many aspects from the model of socialism accepted as the benchmark by the classics of Marxism-Leninism. Trying to characterize the model of "Socialism with Chinese Specificity" against the background of the whole historical experience of economic thought development, we can conclude about the significant evolution of socialism ideas in the Chinese concept (Zheng, 2017; Tanjangco, et al., 2020).

As well as its approach to "Three (five) Sectors of Economy", "Innovative Economy", "Integral Economic Processes", "Digital Platform Economy", etc. – development ideas grew on the evolutionary ground. With all their differences they are also united by the concept of building a "Harmonious World" of social and ecological balance.

Most contemporary Chinese scholars agree that mankind will have to go through two stages: the first is the harmonization and alignment of the interests of diverse nations, and the second is the achievement of great unity or the so-called "大同, Datong". Some scholars consider that "Harmonious Social Civilization – Datong" will finally represent communism, others introduce the concept as the achievement of universal human values for a global world (Zheng, 2017; Smith, 2019; Tanjangco et al., 2020).

There are also macroeconomic concepts which influenced the structure and course of the PRC's national and regional economic transformation during the "Reform and Opening-up" policy implementation. The first is the concept of the sectoral development of the national economy, the basis of which was developed by three economists of the mid-twentieth century – Allan Fisher, Colin Clark, and Jean Fourastie. According to this three-sector concept of economic development, a country's economy at the initial stage of its industrial development is divided into three sectors. The primary sector includes extractive industry and agriculture, the secondary sector includes

processing – a "heavy and light" industry, and the tertiary sector includes the development of services and a service-oriented economy. Society passes through stages of economic development from the development of the primary economic sector to the tertiary one, and when the tertiary sector becomes dominant, there is a transition from industrial to post-industrial society. The driving force for the development of all three sectors of the economy is the integration between all participants in the production and distribution processes – industrialists, commerce, and the state (Clark, 1940; Scott, 1997).

The concept of Three Sectors of the Economy is very close to the concept of a Triple Helix of the innovation economy, e.g. cooperation of government, industries and science. And it also became obsolete over time and was supplemented by theories about quadruple and quintuple sectors of the economy. According to which, after the industrial base was created, there was a transition to the post-industrial economy, and the tertiary sector of services began to play the dominant role, with a following transition to the stage of the innovative economy in which the main role-playing were the Research and Development (R&D), infrastructure and Technology Media & Telecom (TMT) products. Some researchers call the fifth sector development the likely transition of the innovative economy (IV sector) to a social economy (V Sector) (Mahboob, 2018; Cai & Etzkowitz, 2020).

The sectoral economy model is the basis of most global strategies for building the digital civilizations of the future. In Germany, the further development of the ideas of the economic sectors is known as "Industry 4.0" and the "High-Tech Strategy 2025" , in the US as the "Industrial Internet" . In the PRC this concept is now called "The Digital Economy" . This form of economic development replaced the agricultural and then the industrial economy during the three stages of the scientific and technological revolution (Herrero & Xu, 2018; Ma et al., 2021).

There are many definitions of the Digital or Platform Economy in the PRC, but one representative was given at the 2016 G20 Summit held in Hangzhou in the document "G20 Digital Economy Development and Cooperation Initiative" . It states that the digital economy is a business tactic where digitized knowledge and information is the key production factor, modern information networks are the carrier of information, and information and communication technology (ICT) is the driving force behind productivity and optimizing the structure of the economy (Herrero & Xu, 2018; Ma et al., 2021).

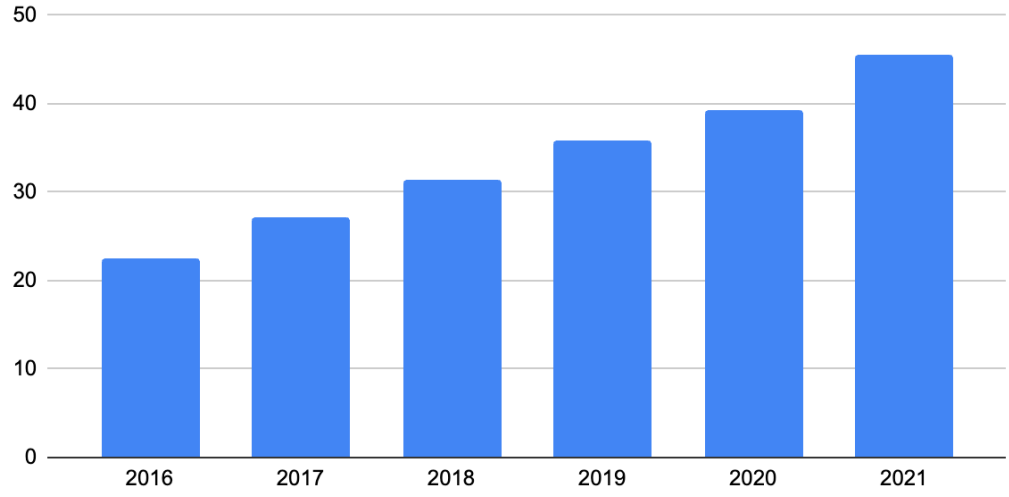
The advancement of China's Digital Economy has been included in the paradigm of major regional and national policy initiatives such as "Internet+" , "Made in China 2025" , "China Standards 2035" , seeking to benchmark advanced technologies such as AI, Cloud Computing, IoT, and Big Data. The

Digital Economy combines corporate initiatives from China's Internet private companies with government initiatives and strategies to integrate traditional industries using advanced information and communication technology (ICT) (Herrero & Xu, 2018; Arcesati et al., 2020; Ma et al., 2021).

At present, the development of the digital economy is based on digital platforms (sharing platforms, search engines, social networks, e-commerce platforms, etc.) and the platform ecosystems they form. These transform entire industries and different types of social and economic activities and become drivers of economic growth, innovation, and competition (Herrero & Xu, 2018; Arcesati et al., 2020).

According to the "The Hong Kong Trade Development Council" (HKTDC), the scale of China's digital economy growth reached 45.8 trillion yuan in 2021, representing 38.2 percent of GDP, with a growth rate three times faster than that of traditional manufacturing and communications technology (See Figure 1) (CAICT, 2022; Arcesati et al., 2020; CGTN, 2020a).

Figure 1: China Digital Economy (RMB Trillion). 2016–2021



Source: Author based on HKTDC (2022), CAICT (2022).

Unlike the manufacturing sector, which has a growth ceiling, the digital creative economy has a wider potential. For example, the construction of 5G stations will not only accelerate the exchange of information, but will also drive technological advances, leading to growth in entire industries of manufacturing, science, and public communications (Herrero & Xu, 2018; Ma et al., 2021).

According to Ma Huateng, founder of the main Chinese mega-platform WeChat Tencent:

"The Digital Economy is an intermediate concept. The Internet, as part of the ecosystem, like water and electricity, is penetrating every industry, and every part of the socio-economic sphere, stimulating the national economy. And soon it will become so commonplace that even references to the digital economy will disappear, just as, for example, today no one talks about businesses using electricity anymore" (Ma et al., 2021).

The next stage after the overall digitization of the economy should be the construction of a global social civilization known in the PRC as the "Harmonious World of the Future" or the "Datong – Society of universal unity". In Japan, where the digitalization of the economy began earlier than in other countries, the principle of the "Harmonious World of the Future" is reflected in the theory of "Society 5.0" (Arcesati et al., 2020). In 2015, the Japanese Government, together with Zaibatsu heads identified major challenges that are hindering the sustainable development of both the Japanese and global economies, and negatively impacting society. These include a shrinking and aging working population, declining global manufacturing competitiveness, the need to upgrade infrastructure, environmental challenges, natural resource shortages, disasters, and terrorism issues. (H-UTokyo Lab, 2020a, 2020b)

The second concept is the "Knowledge Economy". The knowledge or innovative economy is becoming the most important global strategy. Innovation determines the quality of life, economic productivity, and efficiency of socio-economic systems. The concept of "innovation" was introduced more than a century ago by Joseph Schumpeter in "The Theory of Economic Development" (1911). He defined innovation as "the implementation of new combinations". According to the scholar, innovation can develop in the direction of making a new product or a new quality of goods, introducing a new method of production based on scientific discovery, developing a new sales market, obtaining a new source of raw materials, or using new materials, or reorganizing a company. Joseph Schumpeter was also the first to give a definition of a new type of economy – "the innovative (intellectual) economy" or "the economy based on the application of scientific knowledge" (Hospers, 2005; Collinge & Staines, 2009).

The system of scientific knowledge, new technologies, innovative processes, products, and services, as well as new forms of production organization becomes the dominant economic growth drive in the countries to build a knowledge economy. Innovations become a strategic factor of growth, influence the structure of social production, modify the economic organization of society, and could contribute to stabilizing the social situation. The process

of formation of NIS is most intense in developed economies of post-industrial countries. Depending on national characteristics and economic potential, different types (or models) of NIS are formed (Collinge & Staines, 2009; Lundvall, 2010; Atkinson, 2014).

Christopher Freeman, Bengt-Åke Lundvall, and Richard Nelson are considered the founders of the theory of NIS formation. They analyzed the development of innovation activities in different countries and, on this basis, defined NIS. Their research was based on the results previously obtained by Joseph Schumpeter (who developed the theory of economic dynamics), Friedrich Hayek (the concept of dispersed knowledge), Douglass North (institutional theory), Robert Solow (the role of NTP in economic growth), Paul Romer and Robert Lucas (new growth theory). Each of the authors proposed their own definition of the NIS, focusing on its elements and interrelationships. At the same time, they all adhered to common principles (Collinge & Staines, 2009; Lundvall, 2010; Svarc & Dabic, 2017):

- Knowledge plays a special role in economic development;
- The main factor of economic dynamics is competition between entrepreneurs, which is based on innovation;
- The institutional context of innovation has a direct influence on its content and structure;
- The transformation of economic and international processes in the 21st century is characterized by an increasing role for the knowledge sector in the development of innovative technologies;
- The choice in favor of the innovation economy or the so-called "knowledge economy" is becoming evident;
- Innovation is a powerful catalyst for regional development, and innovative development of states and individual territories, studies of experience in the practical implementation of effective concepts are of interest to various fields of science.

The main characteristics of the NIS should also be noted, such as:

1. Systemic nature, i.e. considering it as a set of specifically interacting elements;
2. The institutional aspect, i.e. the influence of existing formal and informal institutions in society on the rate and scale of innovation development;

3. Dissemination of new knowledge and technologies as the main function of the NIS.

Since the early 1990s, the concept of the NIS has been used in studies carried out by international organizations, including the OECD, as well as in the policy programs of individual states (Collinge & Staines, 2009; Lundvall, 2010; Atkinson, 2014).

Currently, the concept of NIS has been widely developed in science in the following main areas: approaches to the definition and typology of innovation; research into the development of NIS, the conceptual apparatus, state innovation policy; research into the dynamics of innovation processes; analysis of innovation at the enterprise level; development of models of scientific and technological progress and consideration of factors characterizing intellectual and innovative activity in the construction of macroeconomic production functions. Despite the wide variety of studies on NIS, there is as yet no universally accepted definition of the term (Collinge & Staines, 2009; Lundvall, 2010; Chen & Guan, 2011).

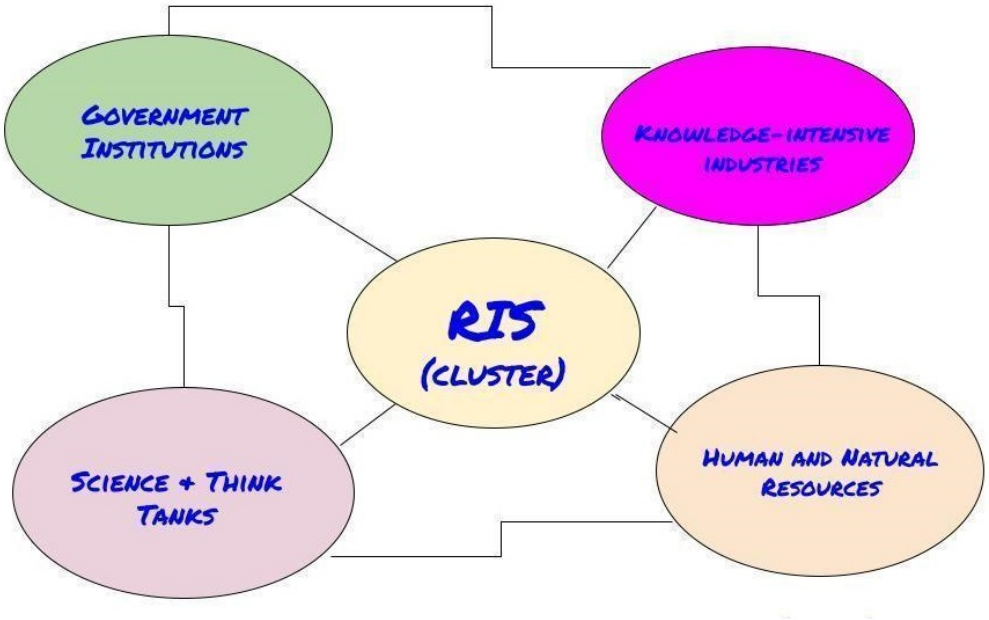
There is no consensus on the essence, structure, and functions of NIS, which are largely determined by national characteristics. For example, some researchers understand the innovation system in a narrow sense, as a scientific and technological system that primarily includes the institutions that generate new knowledge –universities, research laboratories, high-tech corporations, and innovative businesses. Other researchers understand the term ″innovation system″ in a broad sense, not only as production but also as dissemination, assimilation, and use of knowledge through learning processes between economic actors, experimentation, and improvement of technologies and products in the process of their use. (Godin, 2009; Atkinson, 2014).

The dominant approach in the PRC's conceptualization of the NIS is to consider its development as part of a national strategy to build a ″Small Prosperity – 小康 Xiaokang″ society in the course of the ″Reform and Opening-up″ policy through the Four Modernizations – Industry, Agriculture, Military Sector and Science and Technology. The formation of the NIS is seen as a natural outcome of reforms and modernization and the establishment of a post-industrial, ″Harmonious World″. Such a state should have a system of flexible horizontal interactions between all economic actors, allowing them to quickly generate, absorb and disseminate new knowledge. At the same time, PRC's NIS is a set of legal, financial, and social institutions that ensure innovation processes and have strong national roots, traditions, and political and cultural peculiarities (Chen & Guan, 2011; Prodi et al., 2016).

B. A. Lundvall attempted to combine all approaches described above as several complementary subsystems of the NIS within the BRICS (Brazil,

Russia, India, China, South Africa) cooperation project through a comparative study of the NIS of these major emerging economies. In addition, the concepts of the supranational innovation system and global innovation system, have recently been widely used, as well as of sectoral innovation system and regional innovation system (Lundvall, 2010).

Figure 2: Regional Innovation System (RIS)



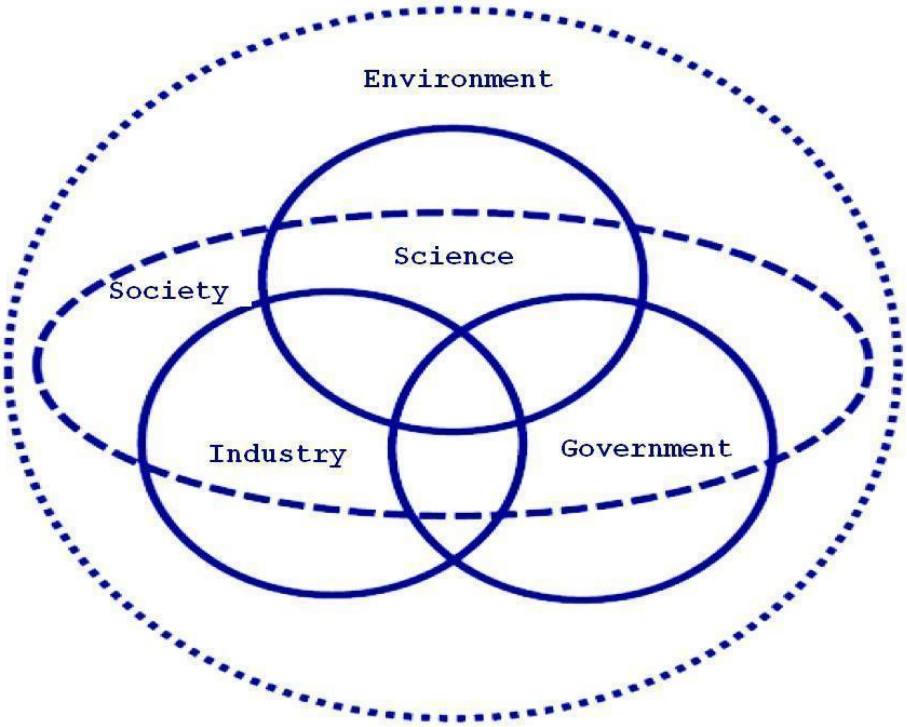
Source: Author based on various publications.

This research is largely based on the concept of state development according to the "National Innovative System", in particular on the concept of "Regional Innovation Systems". A Regional Innovation System (RIS) encourages the rapid diffusion of knowledge, skills, and best practices in a geographical area (cluster) that is larger than a city but smaller than a country. The boundary of a RIS can be conceptually and institutionally drawn around the economic, social, political, and institutional relationships that give rise to a process of collective learning within a linked group of technological or functional domains (See Figure 2) (Collinge & Staines, 2009; Godin, 2009; Lundvall, 2010).

It should be noted that the concept of developing innovative economies or national and regional innovation systems has also undergone significant

changes over time and with the advent of economic digitization. So, in 2010, the concept of a ″quintuple″ or ″five-link″ helix model was introduced and proposed by Elias G. Carayannis and David F. J. Campbell (See Figure 3)(Carayannis et al., 2012).

Figure 3: Quintuple Helix Model



Source: Author based on Carayannis and Campbell's studies

The theoretical model of this kind was a natural outcome of the complementary concepts of the ″quadruple and triple helix″ , which was actively used in studies of the innovation economy and which required to be updated due to the rapidly changing realities. If the ″triple helix″ embodies the model of structural interaction between business, the scientific community (universities), and government agencies ″at each stage of formation of an innovative product″ – for example, an economically and infrastructurally developed territorial unit, the ″quadruple helix″ is an upgraded version of the approach and takes into account other subjects of interaction, i.e. it offers a kind of cycle of innovation process implementation, in which a competitive product is created by the interaction of four keys. The scientific community

(universities, research centers), in addition to their direct research and educational tasks, are called upon to integrate into the process of innovation creation. In the "quadruple helix" model, this actor plays a key role, as universities are transformed into a kind of innovative environment where the acquired knowledge is reflected in new products and technologies, for which there is a demand from the fourth element, the society (Carayannis et al., 2012; Cai & Etzkowitz, 2020).

Another fundamental element is added to the Quintuple Helix – the environment; in such a scheme, business is interested in creating new innovative products and technologies needed for development, so it invests capital in scientific activities or forms separate research units within its structure, but its activities must cooperate not only with the government, science, and society but also maintain the environmental sustainability. This whole model is being implemented in contemporary China, especially with the examples of the modern RIS, and urban clusters in the Bay Areas – the Greater Bay, Hangzhou Bay, and Bohai Bay. The Government generally acts as a manager or venture capitalist (Prodi et al., 2016; Song et al., 2019).

Thus, the augmented model is designed to better reflect the realities of modern post-industrial society, based on the premise that in the economic realities of a partially globalized world, civil society and an environmental balance are important in the creation and distribution of goods and values, and business and government activities should be focused on applying the developments created by citizens in innovative start-up projects (Prodi et al., 2016; Song et al., 2019; Cai & Etzkowitz, 2020).

PRC government planners, in particular, propose the following flowchart when determining the "smart specialization"for building a regional innovation development strategy (Prodi et al., 2016; Song et al., 2019):

- Step 1 – analyzing the regional context, environment, and innovation potential;
- Step 2 – ensuring government involvement and support;
- Step 3 – forming a common vision of the region's desired future;
- Step 4 – setting priorities for harmonious development;
- Step 5 – implementing the infrastructure plan;
- Step 6 – determining how to monitor and evaluate results.

The process of knowledge creation and dissemination is now more complex and requires the synergy of different spheres: government, science and think

tanks, industries, civil society, and a harmonious "green" environment, and their synergy is the driving force behind the formation of elements such as RISs and clusters. (Prodi et al., 2016; Wei, 2018; Song et al., 2019).

In practice, the actual "Quintuple Helix" concept has only recently begun to be implemented, initially by the Nordic countries and some US states, but interest in it quickly arose among governments and academia in other countries as well, particularly in the PRC. Since 2012, all of China's development plans have included the idea of the harmonious development of government, business, science, and the environment. And the most common implementation of the model in practice is the formation of technological clusters (development regions) and the introduction of "smart specialization" in the development strategies of individual (local) spaces. (Yu et al., 2014; Prodi et al., 2016; Wei, 2018; Song et al., 2019).

Initially, elements of the "Quintuple Helix" were implemented in Sweden and Finland, as the Scandinavian "welfare state" provides for greater involvement of civil society by representatives of various public communities, environmental organizations, and trade unions in the process of making political decisions of foreign and domestic policy. Thus, a gradual increase in investment in scientific research and business is one of the main theses of the Europe 2020 strategy, which became the European Union's response to the challenges of the economic crisis (Cai & Etzekowitz, 2020).

Increased investment in research, innovation, and entrepreneurship is at the core of the strategy to develop RIS. This is the only way to ensure economic growth that is smart, sustainable, and inclusive. A key element of locally oriented innovation policy is "smart specialization" , which includes (Švarc & Dabić, 2017; Cai & Etzekowitz, 2020):

- "Smart" economic growth based on knowledge and innovation;
- Sustainable economic growth based on a more resource-efficient, green, and competitive economy;
- Inclusive economic growth based on increased employment and infrastructure, social and territorial integration.

Increased investment in research and development (R&D), innovation, and entrepreneurship are at the core of the regional innovation systems strategy and a critical means of responding to the economic crisis.

Another concept connected with the innovative economy theory and underlying China's strategy of building a "Harmonious World of the Future" is the theory of integration processes. The concept of "integration" , as well as the theory of integration processes itself, appeared in the scientific vocabulary in the middle of the last century. Integration (lat. integer – whole) is

interpreted as replenishment, restoration – a concept denoting the state of connectivity of separate parts and their functions into a whole (Nye, 1968).

Modern science studies the processes of political, social, economic, financial, scientific, and educational integration. The economic component is usually considered to be the driving force behind the integration processes. Economic integration, as the unification of economic spheres, deepening of their interaction, and development of ties between them, is also commonly divided into regional, national and global. It is manifested in the expansion and deepening of production and technological ties, joint use of resources, pooling of capital, creation of favorable conditions for each other's economic activity, and removal of mutual barriers (Balassa, 1994).

Economic integration brings together production processes, scientific cooperation, and the formation of close economic, scientific-productive, and trade relations. Economic integration takes place through the establishment of (Herrmann-Pillath et al., 2014; Chase & Chan, 2016):

- Special Economic Zones (where customs barriers are abolished);
- Customs Unions (common customs tariff and common foreign trade policy concerning third countries);
- Single common market (removal of all barriers);
- Economic and monetary union (common economic and monetary policy – supranational institutions).

The process of globalization and the formation of global and national innovation systems is closely connected with the process of regional integration or "clusterization", i.e. the division of territories into regions. Region is defined as "a large individual territorial unit" – i.e., natural, economic, political, etc. The specificity of this concept passes through a set of definitions. For example, Walter Isard argued that the concept of "region" is usually determined by the issue the researcher is studying. Thus, the definitions of natural, economic, cultural-historical, innovative, etc, regions will differ depending on the nature of the study (Duncan, 1961).

The division of territories into regions and clusters, as well as the question of regional and subregional innovative systems and their integration, is highly debatable. Thus, in China, its division into regions and clusters is multivariate and quite controversial. The reasons for this are varied. Cultural and civilizational regionalization began to be developed relatively recently and, therefore, has not reached the same level as, for example, physical and geographical regionalization. The geopolitical, political, and economic China's

regions do not remain unchanged but are subject to relatively rapid changes. China's regional and sub-regional division is very arguable also in the context of international relations (Kim, 2004; Herrmann-Pillath et al., 2014).

The gradual integration and development of the Pearl River Delta Region (PRDR) and further the Greater Bay Area (GBA) Regional Innovative System (RIS) is a key part of PRC's strategy to build a National Innovation System (NIS). The future GBA RIS will be made up of different regions, each with a specific science and innovation ecosystem, unique economic context, and industrial infrastructure. To stimulate regional development, the PRC is actively encouraging the development of regional integration "Smart Specialization" strategies. Such strategies should be tailored to the individual characteristics of the region; they cannot be developed solely at the national level. The essence of the idea is that a regional strategy should be shaped based on the advantages and potentials of a particular region. A smart specialization strategy can be based on existing strategies, but only insofar as they have been developed for the region in question and their adequacy can be proven empirically (Herrmann-Pillath et al., 2014; Song et al., 2019).

RISs can also be defined as "Functional Economic Clusters" – in some cases cross-border – integrative networks of innovation actors, such as companies, research and education institutions, and public authorities (Chen & Guan, 2011; Song et al., 2019).

The Greater Bay Area – announced by the PRC's State Council in 2017 – is an example of a cross-border regional innovation system, where public policies will be aligned with the region's needs and the resources of the region are used strategically, considering global, national, regional and local factors (Yu, 2021).

Innovation, integration, and competitiveness are closely linked; although one does not generate the other, all three are necessary for the creation of the innovative system. It should be noted that the PRDR is unique because of its geopolitical position, the proximity of Hong Kong and Macao, and its historical development as a crossroads of different cultures and one of China's contact points with the outside world. The PRDR was chosen as an experimental launching pad for developing integrational processes and the application of innovative economy concepts in line with the "Reform and Opening-up" policy. During this experiment, the Chinese government has studied the scientific and practical international experience in developing and constructing advanced special economic zones and then innovative economic clusters, such as Silicon Valley, Tokyo Bay, San Francisco Bay, and others. As a result, Shenzhen has been the first experimental metropolis in which the most innovative strategies for structuring space and society, and applying the digital economy have been tested (Yu, 2021; KPMG, 2020).

Therefore, the analysis of the formation and development of Shenzhen and the regional policy and innovation economy of the PRC NIS as a whole is essential for understanding the development vector of innovation clusters, global cities, digital economy, and "Harmonious World of the Future".

2.3 The Urban Concepts

As already noted, the construction of modern RISs in China is not only based on industrialization and post-industrial economic concepts of building a NIS or a future "Harmonious World Civilization", but also in close connection with the processes of PRC's accelerated urbanization. In the past, urbanization processes have not been well controlled or regulated. Cities and similar settlement systems have been largely self-organized and self-developed over a long period of history. Slowly, they accumulated useful urban components and eliminated unnecessary ones. But with the passage of time and advances in science and technology, the nature of how cities and urban systems emerge and form has changed radically. Nowadays cities rarely emerge spontaneously or chaotically; urban planning processes have become systematized and follow explicit national plans and are based on urban and infrastructural innovations.

Since the "Reform and Opening-up" policy China's modern cities are built according to the government's plan using advanced urban planning technologies and, within a few decades, are transformed into major socio-economic centers, megacities, development centers, important clusters of the RISs – as the example of Shenzhen, Zhuhai and the creation of the PRDR. Most of China's cities are subsumed in urban agglomerations – and are clusters of RISs. Cities, increasing in size, grow, merge, and integrate with each other, often displacing and destroying wildlife. As a result of the two parallel and interrelated processes of industrialization and urbanization, the environment in and around cities has been polluted by industrial emissions, exhaust fumes, sewage, solid waste, toxic chemicals, etc. Therefore, the primary task facing the government is to find measures that effectively influence the self-regulation of the natural environment and reduce the negative consequences of human activities interfering with the natural environment, i.e. the construction of an engineering infrastructure that protects the environment becomes a priority. In modern urban studies, great attention is paid to ecological safety of the urban environment, which is based on a general ecological assessment of modern regional systems, including analysis of parameters of the environment, ecological and integral assessment of the urban environment, as well as analysis of natural and anthropogenic factors. (Prodi et al., 2016; Lew & Park, 2021).

However, the processes of urban design, analysis, and forecasting involve the use of special calculations aimed at considering demographic, socio-economic, environmental, spatial, and other factors affecting the development of the urban environment. The complexity and multidimensionality of urban processes do not allow making urban planning decisions based on one comprehensive model of the city. Therefore, the analysis of individual characteristics of the specific urban environment becomes very important for solving the problems of urban design. To this end, the urban ecosystem is considered as a connection of its functional elements: urban-ecological (natural and anthropogenic), natural-climatic, and geo-ecological. Currently, when considering the development of modern Chinese cities and RISs the terms "Green Urbanism", "Landscape or Eco-urbanism" and "Smart Cities" are widely used, in connection with which a clear distinction between the relevant concepts is necessary (Pow & Neo, 2015; Prodi et al., 2016; Lew & Park, 2021).

The word "urbanism" came into use as a scientific term in the early twentieth century and is the equivalent of the French word "urbanism", which comes from the Latin "urbs" meaning "city". "Urbanism" is often viewed as a twentieth-century direction in urban planning which declares the predominant role of cities in modern civilization. Urbanization is the process of development of cities, the concentration of the population, and life in cities. The rapid industrialization of the 19th–20th centuries has radically changed the way people live, having caused the resettlement of former peasants in roughly growing cities. In 1900, only 14 percent of the world's population were urban dwellers, while today over 50 percent live in cities. The leader of world urbanization is now China, the number of cities with more than 1 million inhabitants is growing there the fastest in the world. Overall, there were 110 "million cities" in China in 2020 (Park, 1952; Lew & Park, 2021).

Modern urban settlements are at the same time man-made and developed environments. A city is not just the sum of its components, but a mechanism inside which there is a complex multilateral system of interrelations between the elements of the urban environment, socio-economic, structural planning, and natural-environmental interrelations. There are also interconnections between the city and its outside environment (the country, the region, the suburban area, and the areas outside it). The nature and intensity of intra-urban and regional interconnections are constantly changing because the links are in constant development and can both strengthen and weaken over time. Innovations made by urban planners in the urban structure cause new, sometimes unforeseen, changes in the systems that make up a city (Nijhus et al., 2020; Lew & Park, 2021).

For example, the construction of bridges and roads leads to a change

in the direction and intensity of traffic flows, a change in the location of public transport stops and a change in the direction of pedestrian flows, and a change in the land situation along highways, an increase in the investment rating of residential areas (previously considered difficult to reach), but at the same time deterioration in the environmental situation along the highways exiting to the bridge, etc. (Nijhus et al., 2020; Ren, 2020; Lew & Park, 2021).

Urban Studies considers a city as a complex heterogeneous non-linear synergy system. A change in one parameter of the system initiates a change in some other parameters, resulting in a change in the balance of system characteristics either locally, regionally, or even nationally or globally. The more intense the changes in urban development conditions, the more they are reflected in the global structure of the urban system (Ng, 2019; Ren, 2020).

In the middle of the 20th century and on the threshold of the 21st century, various perspectives about urban development have emerged and have become an area of research about the future of urbanism and the society itself. Industrial cities had to be designed in a completely new context which required new types of cities to fit into the landscape and environment. New principles which focus on the regulation of the relationship between the city and nature have been put at the forefront. Sociologists and urban theorists have been exploring broader fields such as globalization, urban sustainability, ecology, information, digital technologies, and other interrelated subsystems connected with the urban environment (McPhearson et al., 2016; Lew & Park, 2021).

In the PRDR two main aspects of the development of the modern city can be distinguished from the perspective of the natural and climatic conditions. The first one relates to the development of urban infrastructure, which has made possible a completely different, dispersed system of city planning. The second is a profound awareness of climate change and the consumption of natural resources, which is important and has equally far-reaching consequences since it raises the possibility of entirely new urban design principles. It was necessary to rethink existing cities and their infrastructure systems from an eco-oriented perspective, making them compact, multipurpose, and intelligent. (Ng, 2019).

According to one of the founders of urban systems theory, Nikolai Reimers, an urbanistic system (URB-system) is ″an unstable natural and anthropogenic system consisting of architectural and construction objects and sharply disturbed natural ecosystems″ (Reimers, 1994).

As a city develops, its functional zones, i.e., industrial, residential, and forest-park zones, become more and more differentiated. The industrial zones concentrated factories of various branches – metallurgical, chemical, machine-building, electronic, etc. They are the main sources of environmental pollu-

tion. The intensification of urbanization processes and the sprawl of urban systems lead to the increased complexity of urban infrastructure. Transport and transport facilities begin to occupy a significant space: motorways, petrol stations, garages, service stations, railways with their complex infrastructure, including underground railways – subways; airfields with service complexes, etc. Transport systems are crossing all functional zones of the city and influence the whole urban environment. (Reimers, 1994; McPhearson et al., 2016; Clothey & Dilworth, 2019).

The human environment under these conditions is a complex of abiotic and social environments, jointly and directly affecting people and their economy. Thus, urban systems are a concentration of population, residential and industrial buildings, and structures. Urban systems depend on fossil and nuclear energy and are artificially regulated and maintained by humans.

The environment of urban systems, both geographically and geologically, is the most altered and artificial. The problems of recycling and reutilizing the natural resources involved in circulation, pollution, and environmental cleaning arise, and economic and production cycles are increasingly isolated from the natural exchange of substances (biogeochemical turnover) and energy flow in natural ecosystems. And finally, the highest population densities and man-made environments threaten not only human health but also the survival of all humanity. According to the URB-systems theory – human health is an indicator of the quality of this environment (Reimers, 1994; McPhearson et al., 2016; Chen & Lu, 2019).

The theory of urbanized systems correlates with the ideas of eco-urbanism. One of the founders of eco-urbanism was Robert Ezra Park. According to him, the placement of major urban settlements and the distribution of different areas within them are based on natural, landscape-inspired principles. Cities do not grow randomly, but rather follow the prevailing characteristics of their environment. Thus, for example, vast areas of urban development tend to develop in river deltas, on the banks of marine bays, on fertile plains, and at the intersection of trade routes or railways. To quote Park, ″Once established, a city proves to be a great sieve which unmistakably selects from the population of the country as a whole those who are best suited to live in a given area or a given environment″ (Park, 1952: 7)

Cities come into line with their surrounding ″natural environment″through processes of natural selection, taking over their ecological niche and establishing themselves in it, i.e. through the same processes that take place in biological ecology. According to ecology, the characteristics of the location, movement, and re-location in a new place in an urban environment are similar to those of nature. The different urban areas develop through the adaptation of the inhabitants struggling for livelihoods. A city is a set of

zones that differ from each other in their social characteristics (Clothey & Dilworth, 2019).

"Landscape urbanism has no conflict with nature. If now we fight it, try to expel it from our cities, rigidly subdue or destroy it, then ecological urbanism combines the natural world and the urban world in the best possible way, creating urban oases. At the same time, the city remains and even becomes even more functional through relaxing green spaces. The bottom line is an effective hybridization between nature and engineering" (Clothey & Dilworth, 2019,55pp.),

Urbanized systems and eco-urbanism, in particular, are the basis for intelligent urbanism and green urbanism. Intelligent and green urbanism are key concepts used by the PRC government in the design and construction of its regional innovation systems and the development of the "Harmonious World of the Future" (Chen & Lu, 2019; Ng, 2019).

Intelligent urbanism is a concept of urban space planning developed by Christopher Charles Benninger to address various urban planning problems through ten principles: balance with nature, balance with tradition, appropriate technology, friendliness, infrastructure efficiency, human scale, a system of opportunity, regional integration, balanced movement, institutional integrity (Benninger, 2002).

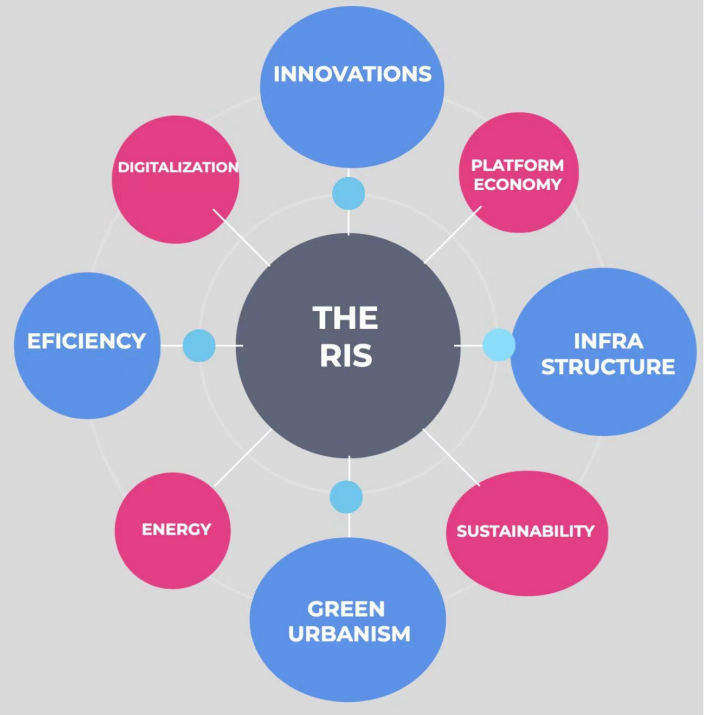
Initially, the impetus for the development of "Green Urbanism" or sustainable construction was the energy crisis of the mid-1970s. The whole world was faced with the problem of saving energy and searching for alternative energy sources. Not only the problem of limited resources but also the model of economic development, oriented towards quantitative growth, became evident. There was a growing consciousness that an extensive economy is self-destructive and thus "unsustainable" . The UN doctrine of "sustainable development" became the new economic model. Sustainable development doctrine that was adopted in 1987 by the World Commission on Environment and Development (WCED):

"Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development does not imply quantitative growth, but qualitative change, establishing harmony between nature, economy, and society" (Pauleit et al., 2011, 9pp).

"Green Urbanism" was coined as an urban planning concept aimed at improving zero-emission and zero-waste urban planning, which emerged at the turn of the 1990s and was enshrined in a UN doctrine, promoting compact, energy-efficient urban development by seeking to change existing urban design principles. The basic idea is to create environmentally integrated and sustainable urban development that delivers and enhances environmental

benefits locally, nationally, and globally (USEPA, 2009; Pauleit et al., 2011).

Figure 4: Smart Cities concept map



Source: Author based on different sources.

The formation of a new landscape by green urbanism concept implies a collaboration of scientists, urban planners, economists, architects, ecologists, engineers, physicists, sociologists, and other specialists in a wide range of disciplines. Green Urbanism is based on minimizing the use of energy, water, and materials at each stage of use. It is also based on efficient carbon reduction, eco-oriented design of buildings and facilities, predominantly natural materials used in construction, and the sustainable use of existing resources. The recycling of different types of waste, to generate more energy, also plays an important role. To make cities more sustainable, urban planners need to understand and apply the basic principles of green urbanism in a systematic and step-by-step way. These principles can be effective in a wide variety of urban situations, but they almost always need to be adapted to the context and scale of the project (Ng, 2019; Clothey & Dilworth, 2019).

"Ecological urbanism is the relationship between nature and man, where the latter ceases to consider nature as an enemy and thinks about how to

make the most of its benefits. And not only in economic terms (fossils, transport) but also in landscape design. So, for example, one can imagine a cascading park along the bed of a dried-up river, similar to the ancient ″amphitheaters″ , preserving the natural landscape. And the beautiful gently sloping hills on the outskirts will be used to build a residential complex with penthouses″ (Ruano, 2021).

Today as part of building China's NIS, the entire country is being transformed according to the principles of ″Green Urbanism″ into RISs consisting of Smart Cities (See Figure 4).

China is now considered a world leader in the ″Smart Cities″ principles implementation. As far back as 2017, Economic Information Daily reported that more than 500 cities in China have begun to adopt smart infrastructure technologies. 300 cities in the PRC participated in the pilot project, and more than 300 more signed agreements with IT companies such as Ant Financial, Tencent, and others. 95% of provincial centers and 83% of provincial cities in the PRC said they wanted to adopt smart technology (Yu & Xu, 2018; Xiao et al., 2019).

The ″Smart City″concept, also known as the ″Smart City 2019+″, is based on the ideas of the Digital Economy – on the development of Information and Communication Technologies (ICT) and Intelligent Transport Systems (ITS). These technologies are designed to revolutionize the infrastructure of smart cities, increasing safety and control over human flows. By the possibility of using 5G mobile networks, and recognizable sensors placed at various parts of the smart city infrastructure, the city is transformed into a single information ecosystem. (Yu & Xu, 2018; Xiao et al., 2019; Ma et al., 2021).

The development of PRC RISs consisting of ″Smart cities″ is carried out with the involvement of international experts. The system consists of six qualitative and 14 quantitative categories, which are further broken down into dozens of key factors and key components, hundreds of target indicators, and thousands of measures to monitor the implementation of solutions (Hu, 2019a; Xiao et al., 2019).

In a global sense, sustainable and harmonious development of large cities and regional innovation systems today is not only based on scale and density, but it is also directly linked to economic growth, social diversity, infrastructure, ecology, and governance practices.

3 ″Reform and Opening-up″ Politics Implementation

The most important milestone in the development of the region under study and Guangdong Province as a whole was Deng Xiaoping's selection of it as an experimental site for the implementation of reform and openness policies.

The Shenzhen and Zhuhai Free Economic Zones were built as buffer zones for further integration with the then former colonies of Hong Kong and Macao. Measures to liberalize the economy and planning, attract investors, develop the service sector and high-tech industries adopted in the free economic zones later spread to other regions and allowed the whole of China to make a giant leap in its development. This chapter progressively reviews the lamdmarks of politics and reforms, transforming the Pearl River Delta into the regional innovation system of the Greater Bay Area.

3.1 New Confucianism and Socialism with Chinese Characteristics

Until the middle of the 20th century, China was plagued by poverty and internal contradictions. Sun Yat-sen proposed ″nationalist-democratic″ ideas, which led to the establishment of the ″Revolutionary Alliance″ in 1905, the Nationalist Party (Guomindang or GMD) in 1912. The Xinhai Revolution of 1911 overthrew the ″Confucius Monarchy″ represented by the Qing imperial dynasty. And later the ideological contradictions between the Guomindang (GMD) and the Communist Party of China (CPC) – founded in Shanghai in 1921 with the assistance of the Comintern. The result was the society split and, following the Japanese occupation during the Second World War and the ensuing Civil War 1946–1949, the communists assumed power, and the People's Republic of China (PRC) was founded on 1 October 1949 (Mühlhahn, 2019).

After the creation of the PRC, China's official ideology was based on Marxist-Leninist theory. But the Confucian tradition was still strong among the general population. Mao Zedong, who wanted to reinforce the authority of his ideas, often said that ″if a leader has no 'ism' of his own, he may be overthrown in his lifetime by others, and he may also be attacked after death″ . For example, the ″Criticism of Lin Biao and Confucius″ campaign (1973–1974) during China's ″Cultural Revolution″ , targeted not only the Great Master but also other ideological opponents of Mao, as Deng Xiaoping (Knight, 1990).

Confucianism emerged in the 5th and 4th centuries B.C. as a response

to the breakdown of Chinese society and its transition to a centralized state system. One of the key concepts of Confucianism is ″Xiaokang″ (小康), a society development stage in which duty (义 Yi) and ritual (礼 Li) are decisive in appointing positions in government, choosing the mode of government, and family and economic matters (Bell, 2008).

At the turn of the 19th and 20th centuries Confucianism was reformed, and one of the leaders of this reform, Kang Youwei, in his interpretation of the doctrine of the ″Three Eras of Historical Development″ interpreted the Xiaokang ″as the ″Era of Minor Tranquility″ or the ″Era of Formation″ , followed by the ″Era of Great Unity″ (大同 datong)″ . The term ″Xiaokang″ also implies the construction of a middle-income society. According to Mengzi – one of the prominent representatives of the Confucian school – the material well-being of the people comes first. A true ruler by Mengzi ″will allow the people to engage themselves in their welfare without hindering them″ (Bell, 2008).

Deng Xiaoping, the CPC Mao's leadership successor, learned from Singapore, whose government was able to transform a country without any natural resources into a strong economic power. He was particularly influenced by Lee Kuan Yew, who based his Singaporean reforms on Confucian principles, and learned more about the results of Lee's policy in Singapore during his visit there in 1978. He was imbued with the idea that with competent management even a poor country can achieve impressive progress in a few decades with a well-thought-out, pragmatic implementation of modernization (Vogel, 2011).

Alongside Singapore, neo-Confucian ideas of building a small affluent society – the Xiaokang – was also the basis of Taiwan's transformation, often attributed to Chen Lifu. In November 1972, members of the GMD promulgated the ″Xiaokang Plan, or Program for the Eradication of Poverty in Taiwan Province″ , whose main provisions were aimed at social and economic development on the island. The plan paid special attention to employment, vocational training, education, the construction of housing for the poor, and other social programs (Schak, 1989).

At the same time, Mao Zedong used the term ″Xiaokang″ in a negative way, as a symbol of wealth and private-proprietary interest. Following Mao's death in 1976, the Cultural Revolution was criticized, the Gang of Four was put to rest, and Deng Xiaoping was reinstated in his leadership positions (Vice Chairman of the CPC Central Committee, Deputy Chairman of the CPC Central Military Commission, and Chief of the PLA General Staff). The future reforms plan were influenced by the Singaporean and Taiwanese experience, and so in 1978, at the 3rd Central Committee Plenum, Deng Xiaoping announced the following slogan: ″Practice is the Criterion of Truth″

(实践是真理的标准, shixian shi zhenli de biaozhun). It meant that henceforth the only measure of any activity would be its result: the wellbeing of society and the increasing power of the state. For this reason, the plenum set the stage for the ″Four Modernizations″ – agriculture, industry, defense, science, and technology. A year later, Deng Xiaoping formulated the following conclusion: ″Socialism must also engage in a market economy″ (Vogel, 2011).

Unlike other countries in the region, Deng Xiaoping planned to build ″Confucian Socialism″ rather than ″Confucian Capitalism″ . For this reason, the focus of economic transformation was primarily on the peasantry. Confucian agrarian policy implied the preservation of small private property, so the Chinese chose socialism as an alternative to capitalism because they saw in capitalism a real threat to the small peasant economy, the basis of their economy. Peasants were now seen not only as ″representatives of the advanced productive forces of the village but also as representatives of advanced morality among the modern peasantry″ (Bell, 2008; Vogel, 2011).

The main attention in the implementation of economic reforms was paid to the creation of the ″middle level of affluence″ . Ma Hong, President of the Academy of Social Sciences of the PRC, developed a program to achieve this level, including the following postulates (Ma, 1981):

1. The entire people will live with abundant clothing, abundant food, peace, and tranquility, per capita production of consumer goods and services will increase, the country will reach the level of full provision of basic needs (″温饱″ wenbao);

2. The life of the people will be comfortable but not wasteful. The country will achieve the middle level of affluence (″小康″ xiaogang);

3. This will follow up by the creation of an ideal society of universal prosperity (″大同″ datong) when the life of the people will reach the living standards of developed countries.

At the XIII National Congress of the CPC (1987) acting General Secretary Zhao Ziyang delivered a speech on ″Advancing on the Path to Socialism with Chinese Characteristics″ . He pointed out that China is a socialist society, but that socialism in China is in its initial stage, which is a Chinese peculiarity due to the country's underdeveloped economy. At this stage of development, Zhao recommended the introduction of a planned commodity economy based on state ownership. The main failure of the PRC's previous policies, according to Zhao, was that the Chinese leadership did not admit that China could achieve socialism by passing through the stage of capitalism (Shirk, 1990).

"The Economy at the Beginning Stage of Socialism"(1987), by the economist Yu Guangyuan, suggested that this stage would last two decades and possibly much longer. The same year, Zhao Ziyang outlined the concept of the "primary stage of socialism" and stated that the party line should follow "One Center, Two Main Points" – the central focus was the economic development, but through centralized political control (i.e. the Four Cardinal Principles) and maintaining "Reform and Opening-up" policies (Shirk, 1990).

General Secretary Jiang Zemin developed this concept a decade later, first during a speech at the Central Party School on 29 May 1997 and then in his report to the 15th National Congress on 12 September 1997. According to Jiang, the 3rd Plenum of the 11th Central Committee (1978) analyzed and formulated a scientific program on the problems facing China and socialism, and the initial stage of socialism was an "unexplored stage". The fundamental task of socialism is the development of the "productive forces", and therefore the main objective during the initial stage must be the further development of the national economy. He also added the idea of "Three Representations" according to which not only workers and peasants but also entrepreneurs, previously regarded as the "capitalist elements", could be members of the CPC (Tisdell, 2009). President Xi Jinping in 2013 said that the "Reform and opening-up" policy had achieved the "wenbao", and announced that, "By the centenary of the founding of the Communist Party of China (2021), the goal of a middle-wealth society will inevitably be realized. By the centenary of the founding of the PRC (2049), the task of building a rich and powerful, democratic and civilized, harmonious, and modern socialist state will be fulfilled. The dream of the great rebirth of the Chinese nation will certainly come true" (Xinhua, 2013).

3.2 Four Modernizations

The beginning of China's comprehensive transformation is associated with the "Reform and Opening-up" policy, in the late 70s. However, there is debate about the date of the reforms start, so some researchers consider that the course of implementation of the "Four Modernizations" (四个现代化 si ge xiandaihua) – agriculture, industry, defense, science, and technology – was taken by Mao Zedong as early as in 1955–1965, but due to the Cultural Revolution (1966–1976) and various internal and external contradictions, it could not be implemented that time (Wang, 2011).

The direct losses of the national economy during the so-called "Great Leap Forward" (1958–1960) exceeded 100 billion yuan. The decade of the Cultural Revolution (1966–1976), caused a disruption of the party, state, and administrative apparatus. The gap between China and developed countries

had grown, and the standard of living of the rural population, in particular, had not risen for a long time (Wang, 2015).

After Mao's death in September 1976, a group of pragmatists led by Deng Xiaoping came to power in the country, they had to conduct a "comprehensive streamlining" of all administrative and economic life by setting the tasks of creating an effective production management structure, reforming the center-local relationship system by transferring some powers to grassroots organizations, simplifying the military and administrative machinery, restoring the regulatory framework, introducing a system of accountability to the local government. All these decisions subsequently became an integral part of the program of China's modernization developed by Deng Xiaoping, with the central idea of the priority of economic construction first formulated by him in the 1950s (Vogel, 2011).

In December 1978, the third plenum of the 11th CPC Central Committee summarized the experience of the previous period in building socialism in China and condemned the mistakes made mainly during the "Cultural Revolution" (1966–1976). The plenum noted that the country's economy had stagnated for more than a decade and that, as a result, many problems had accumulated in the life of the Chinese people. The Plenum set out to carry the aforementioned "Four Modernizations" – agriculture, industry, defense, and science and technology – which were to lead to an improvement in the people's material condition. Thus, this Plenum marked the beginning of a new stage in China's development – the stage of reform. Deng Xiaoping became the chief reformer of the economy and the main leader of the country. He shaped the key theoretical and programmatic provisions of the reform strategy. The goal of socialist modernization was to bring China by the middle of the 21st century to the level of average developed countries in per capita production and, on this basis, to achieve the general welfare of its citizens (Vogel, 2011).

The way of modernization was accelerated economic growth, qualitative renewal of the economy, and increasing its efficiency based on the development of scientific and technological potential. Science was the "main productive force" (重要生产力 zhongyao shengchanli), and its development was declared the most important task of economic construction. The role of intellectual labor, associated with the development of science and technology, was increased to carry out modernization. Socialism was the base for the necessary concentration of material and human resources to accelerate socio-economic development and achieve the general welfare, not allowing the concentration of public wealth in the hands of a small part of society (Wang, 2011).

However, socialism in China was built considering the national specificity,

consisting of historical and objectively conditioned socio-economic backwardness, in conditions of shortage of arable land and other necessary resources to ensure normal living conditions and development of the country with a billion people. Therefore, from the beginning of the development of the modernization strategy, Deng Xiaoping abandoned dogmatic adherence to the canons of socialist construction adopted in the USSR and sought to build his model of ″Socialism with Chinese Characteristics″ . Given that it took a long time to overcome China's backwardness, he adopted the theoretical assumption that China was at the initial stage of socialism, which will last until the middle of the 21st century (Vogel, 2011).

The economic basis was public ownership of the means of production while encouraging the development of non-socialist sectors of the economy, including the private sector. Deng Xiaoping abandoned the opposition between planned and market economy, considering both only as means in the hands of the state, not defining its essence (since socialism, as well as capitalism, uses both the plan and the market). The role of the market was gradually expanded as the main regulator of economic development (Vogel, 2011).

At the initial stage, the reforms were aimed at aligning production relations with the objectives of the development of the economy to enlarge industrial production. The policy of ″Opening up″ was designed to include China in the process of globalization of the economy. They actively attract foreign capital, use the achievements of foreign science and technology, as well as the managerial experience to increase the global competitiveness of China. Economic reform, according to Deng Xiaoping's theory, was impossible without the reform of the political system. The political and ideological superstructure is the dictatorship of the proletariat under the leadership of the Communist Party of China. The political life of the country is built following Deng Xiaoping's ″Four Cardinal Principles″ (四项基本原则 – si xiang jiben yuanze) (Shirk, 1990):

1. To follow the socialist path;
2. To adhere to the dictatorship of the proletariat;
3. To uphold the leadership of the CCP;
4. To uphold the ideals of Marxism–Leninism, and the ideas of Mao Zedong to ensure the main internal condition for the normal course of reform – political stability.

Figure 5: "The Four Cardinal Principles is the Basis of Statehood", Shenzhen, 2020

Source: Photo by Marina Shafir, 2020.

No deviation from this line toward political and ideological liberalization was allowed. The content of the reform of the political system consists in increasing the efficiency of the existing system of representative bodies of power (meetings of people's representatives and so on), expansion of their controlling functions and democratic principles in their activity, simplification, and reduction of the administrative apparatus, clear division of powers between party and administrative bodies, between the center and local, and so on (Shirk, 1990).

The implementation of Deng Xiaoping's reform is inextricably linked to the transformation of China into a modern legal state governed by law while maintaining the leading status of the Communist Party and the existing system of people's representatives and multi-party cooperation under the CPC leadership. Over the years, a huge body of legislation has been developed to regulate all aspects of economic, state, and public life. The ruling party as a guarantor of social and political stability, to successfully pursue the course of modernization, is of special importance both in reforming the political system and in the whole process of modernization, therefore the issues of party building, strengthening of party discipline, and strengthening of inter-

nal party control were constantly in the focus of the CPC leadership.

According to Deng Xiaoping's theory, the main trends determining the state of modern international relations are "Development" and "Peace", the preservation of which is a guarantee of the success of China's modernization (Vogel, 2011).

This program was carried out by the method of "Crossing the River by Groping for Rocks" (摸着石头过河 – mozhe shitou guo he). This slogan is used as a synonym for a cautious approach to solving economic problems. One of the main factors determining the success of China's reforms is the gradual, evolutionary nature of the reform process (Vogel, 2011).

The most important feature of Deng Xiaoping's policy wholly subordinated to the task of increasing the aggregate power of the state and improving the lives of the people. Hence the balanced and responsible approach to the consistency, depth, and pace of change, the desire to avoid radicalism in decision-making (Vogel, 2011; Cable, 2017).

3.3 Rural reform and "10.000 yuan households"

The first of the "Four Modernizations" was the modernization of the countryside and agriculture. China was an agrarian country that experienced the "collectivization" of agriculture in the mid-1950s. "Collectivization" i.e., the transfer to the state and collective farms of previously private land, doubled the size of agricultural land. However, with the creation of people's communes in which the principles of collective property and production were introduced, peasants were forbidden to engage in subsidiary trades, so agricultural communes were often unable not only to feed China's huge population but themselves. According to various studies and different evaluation criteria, 32 to 97 percent of Chinese peasants were living in poverty in 1978 (CGTN, 2020b; Pei, 2018).

The first measure of the countryside reforms was the search for the optimal form of organization of peasant labor, and this form turned out to be the family contract. A family received a plot of land on lease for 3–5 years. Part of the harvest was sold at fixed prices to the state, another part was given to the production brigade as payment for the provided machinery or other assistance. The rest of the crop, which was usually more than a half, was at the family's complete disposal and could be sold on the market. The family contractor could also set prices for the rest of the crop, engage in trades and private enterprise, organize industries, etc. (Lin, 1992; Vinogradov, 2008).

Freed from pressure from above, the Chinese village chose for itself the forms of economic management that were optimal for the conditions of the early 1980s. According to Chinese statistics, in 1978 China's 180 million

farmyards were grouped into 52,700 communes, subdivided into 690,000 large production brigades and 4.8 million small production brigades. And by the end of 1984, only 249 communes, 7,000 large production brigades, and 128,000 small production brigades remained in the country, while 97.9% of peasant households switched to family contracts. In connection with this, the share of income received by peasants from collective farms dropped precipitously: from 66.3% in 1978 to 21.5% in 1982 and 11.6% in 1983. The self-liquidation of the people's communes and the transition of the Chinese village to family contracting led to a renewed process of stratification of peasant farms – into "more prosperous" and "less prosperous" ones (Portyakov, 1998; Vinogradov, 2008). Some of the peasant households went bankrupt, and some peasants abandoned their land and transferred their tenancy rights to a more successful neighbor. More efficient and richer farms began to appear in the village. Wealthy Chinese farms were not oppressed, on the contrary, encouraged (Portyakov, 1998).

At a time when the annual income of many family contractors was not more than 2.000 yuan, family contractors earning 10.000 yuan or more a year (万元户 wan yuan hu) were actively glorified (Liu et al., 2017).

One of the first model villages in which Deng Xiaoping's modernization and market principles were implemented was the fishing village of Yumin, located on the territory of modern Shenzhen on the border with Hong Kong. It began to form in the 1950s when fishermen came to the deserted beaches of the Shenzhen River and began to build huts of bamboo and straw. After the start of "Reform and Opening-up" politics, the villagers built a transport shipyard, developed agriculture, and organized a processing factory, and as early as 1981, the collective income of the village reached over 600,000 yuan. Yumin also became the first village in the country with households earning 10.000 yuan a year (Liu et al., 2017).

The richer and more specialized farms in the Chinese countryside needed wage labor. The 13th Congress of the CPC (1987) decided to legalize land property leasing in China, which was abolished during Mao Zedong's time. The Report and resolutions of the Congress stated that "land property leasing in China and the wage-labor inevitably associated with it at the initial stage of socialism are inevitable and are a necessary and useful complement to an economy based on public property" . Deng Xiaoping said even before the 13th Congress of the CPC, and later repeated the simple thesis several times: "To develop production, we must not fear that some will become richer before others. We must allow some households to become rich earlier and faster than others" . This meant not only allowing but encouraging, the stratification in the Chinese countryside (Portyakov, 1998; Vinogradov, 2008).

Figure 6: The sylph and commemorative plaque in Yumin Neighborhood Park, Shenzhen of Deng Xiaoping visit in 1984

Source: Photo by Marina Shafir, 2020.

The "10,000-yuan household" policy was necessary to develop a multi-sectoral economy in the countryside, educating and nurturing the skills of economic enterprise among the peasants (Liu et al., 2017). This policy brought tangible results both in agricultural production and in the creation of township-village enterprises in rural areas, which become not only one of the pillars of China's rural economy but also an important part of the entire

national economy. In the first 16 years of reform, the gross harvest of cereals (including yams in 5:1 grain terms) was raised from 332.2 million tons in 1979 to 466 million tons in 1995, an increase of 134 million tons (Portyakov, 1998; Vinogradov, 2008).

Eradicating poverty in the countryside, and later in the city, was a fundamental goal of China's "Reform and Opening Up", as well as a criterion for its achievement of the "Xiaokang" level – the society of small prosperity. According to Chinese President Xi Jinping, China has achieved both of these goals in just over 40 years by 2020 (CGTN, 2020b).

3.4 New Industrialization and Economy Liberalization

The main driving force of the reforms was industrialization, with deep and large-scale transformations in the economic base in almost all spheres of the economy. These transformations aimed to accelerate the development of production, increase economic power, and improve people's well-being. Industrialization was inseparable from the general state of the economy, the environment, and the reforms that were to stimulate it.

The new leadership saw the main direction in solving the tasks put forward as the emancipation of the human factor and the intensification of the economic activity of the population. Often in the publications, this line was presented figuratively as the need to break "The Big Pot" (大锅饭 da guofan) and ensure that "Everyone Eats from his Own Bowl" (自食其力 zi shi qi li). This meant the end of centralized management of material, financial and human resources, the elimination of the system of "single procurement and single distribution". Major changes began immediately with the transfer of the semi-natural and subsistence economy to a commodity-money economy and the increase in purchasing prices for agricultural products, as well as the wages of workers and employees (Naumov, 2002; Chow, 2005).

The state banking system was reformed. They opted for intensively managed monetization of the economy, controlled inflation, and sustainable monetary circulation instead of "shock therapy". In some years, managed mini-shocks however were applied to certain groups of goods in the context of their abundance (Galagan & Savinov, 2016). Chinese reformers made great efforts to prevent the still weak and fragile savings and investment environment from collapsing. They consider that the main problem of the savings and investment environment, financial system, monetary circulation, and the economy as a whole was inflation, especially in its most destructive form – hyperinflation (Chow, 2005; Galagan & Savinov, 2016). They have the objective of the preservation of the value of deposits and the return on them, affordable (interest rate) credit, a stable national currency that performs all

the functions of money, and a stable exchange rate. A rise in inflation above 10% is considered as a sign of trouble. In a chronic deficit economy, inflation in the PRC was potentially hidden (Chow, 2005; Galagan and Savinov, 2016).

Major reforms were carried out in state property, enterprises, the financial and credit system, trade, etc. A turning point was the admission of private, individual, and foreign capital into the economy. The economy as a whole expanded and climbed up the ladder of scientific and technological progress. Most of the reforms carried out were directed toward industrialization as the basis for raising the economy and bringing them up to the modern scientific and technological level (Naumov, 2002; Chow, 2005; Galagan & Savinov, 2016).

To reform State-owned industrial enterprises, they did not follow the path of privatization but converted them to various forms of contracting and leasing. There were mainly two types of contracting: contracting to increase realized profits and contracting to reduce losses. The duration of the contracts was set as one to four years. Small enterprises were converted to various forms of leasing from the second half of 1984. Private and small-scale individual entrepreneurship in the industry became widespread (Naumov, 2002; Galagan & Savinov, 2016).

Industrialization was also being extended into the countryside, rapidly changing the structure of the rural economy and becoming "universal". Increasingly the transformation penetrated deeper and deeper into the planning process. In addition to the directive indicators, which were declining in number, the plans began to be guided by indicative indicators. With the growth of agricultural production, the number of goods distributed by coupons was reduced from 44 types to only two – cereals and vegetable oil. Wholesale trade was transformed into large trading centers, remaining largely in the hands of the state and the cooperative sector. The first experiments began to take place on the formation of markets for the means of production. In less than 2 years (1986–1987) their number increased from 6 to 79. The number of means of production distributed by the centers and departments was reduced (Portyakov, 1998; Vinogradov, 2008).

With the expansion of the sales rights of the produced goods, horizontal links between enterprises and regions began to develop. During the reforms, a system and forms combining directive, guided, and market-based circulation of means of production were developed in the sphere of production and marketing. The most important reform that had a great impact on breaking down the system of centralized distribution of financial resources was the transfer of state-owned enterprises from the deduction of profits to the state budget to the tax system. The transformation began in 1980, with exper-

iments. In 6.000 enterprises, they created funds for product development, social security, and bonuses for workers and employees from the part of the profit that was leftover. In 1983, the first step was taken to reform the distribution of profits between the state budget and the enterprise. Taxes were introduced and a partial deduction from profits was retained (Naumov, 2002; Chow, 2005; Galagan & Savinov, 2016).

In 1984 the entire enterprise was transferred to a tax-based distribution system. The result was a progressive reduction of the state budget's share in GDP, which considerably limited the role of the Council of State in the direct use of budgetary resources. On the contrary, the role of local governments at different levels, agencies, and especially enterprises in the accumulation of material resources increased. With the increasing economic activity of the collective sector and the emergence of private, individual, and foreign investors, there was an expansion of the savings base, on the one hand, and a contraction of the public sector in investment, on the other. New sectors emerged, represented by private and foreign investors. In 1995, they accounted for 16.3% of the investment. Major changes occurred in the structure of public sector investment in connection with granting more autonomy to enterprises and places. The share of budget financing declined and the role of bank lending increased considerably. The largest share of investment was concentrated in enterprises. Foreign investors contributed significantly to the investment fund (Naumov, 2002; Chow, 2005; Galagan & Savinov, 2016).

The government actively used the banking system to stimulate investment. From 1992–1993, the investment growth rate was raised to 40% and 60%, to a large extent through bank emissions. Of great importance for economic growth and quality was the accelerated restructuring of foreign trade – the industrialization of exports and imports and their rapid growth. Over 17 years, foreign trade turnover increased from about 20 billion USD in 1978 to 280 billion USD in 1995 – that is, almost 14-fold. Similar shifts took place in imports. During the first 15 years of reforms, imports of manufactured goods increased almost tenfold, while imports of raw materials decreased by 4 times. The share of raw materials in imports decreased and the share of industrial products increased accordingly. Thus, foreign trade has become the most important factor in China's industrialization (Naumov, 2002; Chow, 2005).

3.5 Developments in Science and Technology

The fourth area of modernization was science. During the "Reform and Opening-up" policy, the PRC government adopted a major policy of devel-

oping science and technology. The basic course states (Chow, 2005; Zhong and Yang, 2007):

The State should adhere to the idea (concept) of science and technology (S&T) as the primary productive force in economic construction, the work in this field must be subordinated in order to conquer the heights of science with all possible efforts.

The strategic objectives for the development of science included:

- To strengthen basic research, increase the country's scientific and technological strength and scientific and technological level and multiply technological reserves;
- Increase the quantitative and qualitative contribution of science and technology to socio-economic development, especially its leading role in scientific and technological progress in agriculture, new technologies and their industrialization, as well as in the reconstruction and upgrading of traditional industries;
- Build a new system of science and technology adequate to the socialist market economy system and the regularities of scientific and technological self-development and enhance the vitality of scientific and technological institutions and researchers.

The implementation of a strategy of ″national uplift based on science and education″ was one of the Chinese government's biggest challenges (Zhong and Yang, 2007). State-owned enterprises, for instance, invested about 10 billion yuan in science in 1990 and by 2000 this had increased seventeen-fold to 170 billion yuan (Zhong and Yang, 2007).

In line with the basic course and strategic goals of S&T development, the government carried out overall planning for S&T work, with a three-level development model: ″innovative scientific research serving the main plank of economic construction and social development, high technology development and high and new technology industry, and strengthening basic research″. At the same time, relevant state development plans and programs were drawn up (Xie et al., 2014):

(1) Plan for Addressing Priority Science and Technology Challenges of National Importance ″Storm″ (1982), the main objective was, based on the urgent need to solve major and important scientific and technological problems of economic construction as soon as possible, to take the key technologies of general application that played a supporting role in socio-economic development and influencing the overall situation in this field. The plan was financed mainly by the government with simultaneous contributions from industries and provinces.

(2) The "Spark" program (1986) to promote rural economic development through the application of science and technology. The program was financed mainly through bank loans and the accumulation of public funds with additional financial assistance from the state.

(3) The "863"Programme – A national research and development program in the field of high technology (1986). Its main objective was to play a motor role in the development of high technology to create conditions for the establishment of a high-tech industry with definite advantages after 2000, as well as to prepare the ground for the sustainable and higher-level economic development of the country. The program identified eight areas as priorities in the development of high technologies: bioengineering, space technology, informatics, laser technology, automation, energy, new materials, and world-ocean technology.

(4) The "Torch" Programme (1988). It was a technology absorption program for the high-tech and new-age industries. The objective was to identify the advantages of China's scientific and technological potential and promote the commercialization of high and emerging technology achievements, the industrialization of high and emerging technology products, and the internationalization of the high and emerging technology industry.

(5) State Plan for the Priority Introduction of Scientific and Technological Advances (1990). Its main objective was to create a global environment and conditions for the organized and planned introduction of advanced, ready-to-use scientific and technological advances on the main foothold of economic construction, to promote the close linkage between science and technology and the economy.

(6) Scientific and Technical Programmes for Social Development. These programs cover the period 1996–2010. They were aimed at enhancing the quality of life and natural qualities of the people, improving the living environment and human development, regulating human-nature relations, promoting scientific and technological progress in social and related industries, and promoting the implementation of the progressive development strategy outlined by the Chinese Government. The main areas covered by the program were population, health care, and sanitation, health, management and conservation of natural resources, protection, and improvement of the environment; disaster prevention; housing, and urban and rural development.

(7) "New Knowledge Creation Project" (1998). The state planned to allocate 4.8 billion RMB over 3 years to establish a government system and functional mechanism for intellectual innovation, and to establish innovation centers at the international level, to lay the foundation for the large-scale improvement of the techno-innovation capacity of our country. In 1998, the Government also allocated RMB 1.0 billion to establish the Foundation for

Medium and Small Science and Technology Enterprises, which was designed to understand risk investment mechanisms, support the transformation of scientific and technological achievements into real productive force, and help scientific and technological workers to establish science and technology enterprises (Baark, 2001; Xie et al., 2014).

(8) Science and technology program to strengthen basic scientific research. Relying mainly on the activities of the Natural Science Foundation, the government has promoted the implementation of a program to build priority public laboratories and a program to "conquer the top" of science and technology. These programs and the fund have played a leading role in supporting basic research nationwide (Xie et al., 2014; MOST, 2020).

In line with the strategic objectives and overall S&T development program of China, the government put forward a new reform of the S&T system, the essence of which was "keep the main thing, put down the rest". To "keep the main thing" means to commit to the principle "less is more", according to which to "keep" the best scientific and technical personnel engaged in basic science, high technology research, and key scientific and technical problems of public importance. They should constitute a selective force for breakthroughs. "Putting the rest down" means the scientific and technological development and service structures and most of the public utility structures and, by redistributing their personnel, turning all these structures towards the market. They will be merged into enterprises in various forms or form a variety of enterprises or blocks of enterprises with a scientific and technical profile (Zhong and Yang, 2007; Xie et al., 2014).

By the year 2000, a new S&T system adequate to the socialist market economy system, and the laws of S&T self-development had been established in its initial form. This caused a marked increase in the coefficient of the contribution of scientific and technological progress to economic growth. By 2010, the new science and technology system, which was established, was further consolidated and improved, and the integration of science and technology with the economy was realized so that China became one of the 10 world science and technology powers. During the reform, China's science and technology system has undergone profound changes, and the scientific and technological strength of China has increased significantly. (Xie et al., 2014).

3.6 Opening-up to the World

The main goal of China's new policy was not just to open up the domestic market or the national economy as a whole to the world. It aimed to exploit global opportunities to implement a range of domestic reforms in China,

among them the elimination of economic and social disparities between urban and rural areas, between provinces, sectors of the national economy, and so on.

The essence of the transformation was addressed to change the economic system, which had become an obstacle to development, and gradually replace it with a new system capable of giving this development a dynamic character. The policy of "Opening up" was designed to finance the reforms, primarily by attracting foreign investment and foreign exchange earnings. It was aimed at providing China and its economy with the necessary science and technology, resources, innovation, and other "growth factors", certain imported goods, usually high-tech ones, which China at the time was not yet able to produce by itself. Thus, the main aim of the "Opening up" policy was to strengthen the national economy, balance it, obtain resources that were not available at the time and use external opportunities to strengthen the country in the future, primarily by accelerating economic growth that exceeds demographic growth (Hu and Chan, 2002).

The peculiarities of China's foreign trade commodity structure largely predetermined its geography. China's foreign economic ties were purposefully reoriented from the USSR and the "Socialist Camp" to the world market back in the 1960s. This was due not only to the deterioration of political Sino-Soviet relations but also to the curtailment of imports of complete equipment and Beijing's increased need for grain and other agricultural products, which the Soviet Union and its partners in the Council for Mutual Economic Assistance (COMECON) could not satisfy. The start of the reforms came at a time of another round of deterioration in China's relations with the USSR, first because of the Sino-Vietnamese war in the spring of 1979, and then because of the Soviet invasion of Afghanistan. The priority of western states in China's foreign trade increased, which was aided by the establishment of official diplomatic relations with the USA on 1 January 1979 (Portyakov, 1998; Vinogradov, 2008).

In the transition to an "Opening up" policy, an increase in the number of entities involved in foreign economic relations was of great importance. The era of the monopoly of state-owned export-import companies came to an end. The dual (in the form of state and collective ownership) of the pre-reform economy was replaced by a multiform economy with dynamically growing quantitative and qualitative groups of enterprises of individual, private, share, and joint-stock ownership. After a law regulating joint ventures was adopted in the summer of 1979, China began to actively attract foreign direct investment. In the mid-1980s, in addition to joint ventures, the establishment of cooperative ventures and wholly foreign capital enterprises was also permitted (Tisdell, 2009).

The number of enterprises with foreign investment, especially those with the participation of "Huaqiao" (华侨) (i.e. people of Chinese origin in foreign countries), grew rapidly. In the late 1970s and early 1980s China took advantage of the shift in manufacturing specialization in the more developed countries and regions of East and Southeast Asia, which were looking for a suitable site for moving the production of textiles, shoes, simple domestic appliances, etc., out of the country. In doing so, China tokes the role of processor and assembler, importing raw materials and input components and exporting finished products. This approach, once called by Premier Zhao Ziyang "Placing Both Ends Outward" (两头在外 liang tou zai wai), has for a long time predetermined such an important feature of China's organizational structure of foreign trade as its high share of "processing-based trade" and import-export enterprises with foreign capital (Vinogradov, 2008; Galagan & Savinov, 2016).

The high share of "downstream trade", with the most active participation of enterprises with foreign investment, led to a rapid change of China's foreign trade, with the gradual appearance of increasingly sophisticated products and a concomitant improvement in the country's position in value-added chains. In 1985–1986, for example, clothing, cotton textiles, and grain were China's leading exports, following oil. Of the machine products, sewing machines, electric fans, and bicycles were exported in small quantities. Imports were dominated by rolled steel, followed far behind by cars, grain, timber, and fertilizers. White goods such as televisions, video recorders, washing machines, and refrigerators were imported. In the 1990s, there was a massive export of cameras, televisions, various audio-video equipment, and, at the end of the decade, personal computers (Tisdell, 2009).

The PRC's opening-up reform was pursued through foreign trade liberalization, which was systematically implemented in the first phase of reform over 17 years, from 1979 to 1996. China charted an institutional trajectory, integrating step by step into the global economy. Integration was carried out through the gradual incorporation of individual Chinese regions or their groups, which were granted trade rights with foreign countries (Tisdell, 2009).

In 1979, two provinces, Guangdong and Fujian, for the first time were granted special rights to conduct foreign trade and attract foreign investment. In 1980, four Special Economic Zones (SEZ) were established in which free prices and preferential treatment were applied. In 1984, 14 coastal cities were designated as Special Foreign Trade Zones, in 1988, Hainan Province was designated as a Special Foreign Trade Zone, and in 1992 most of the cities on the Yangtze River were designated as Special Foreign Trade Zones (Shenshina, 2006; Chen, 2007).

The nature of the entitlements differed somewhat at each stage, but all

the while, under the dual liberalization, two exchange rates – the planned exchange rate and the market exchange rate – were maintained. It was not until the end of 1993 that the planned rate was abolished. Enterprises that might have been harmed by this change were compensated by the government for their losses. By that time, the difference between the planned and market exchange rates was 50 percent, but the planned rate only applied to one-fifth of all foreign trade. In 1996, renminbi convertibility was declared for current transactions, but capital transactions remained under strict government control. All this time export industries were supported by the state and an active tariff policy was pursued. Since the late 1990s, it has been supplemented and partially replaced by a policy of undervaluing the real exchange rate through the accumulation of foreign exchange reserves (Fung & Leung, 2001).

The PRC and the United States formally established diplomatic relations in 1979. The U.S. recognized the PRC government as the sole legitimate government of China and Taiwan as an integral part of China. The completion of the unification of the country was also an important part of Deng Xiaoping's modernization program. The unification was planned to be based on the integration concept developed by Deng Xiaoping in 1981 and called the principle of "One Country-Two Systems" (一国两制 yi guo liang zhi), providing for the preservation of the existing capitalist system in Hong Kong, Macao and Taiwan after their reunification with the PRC and includes four key points (Shenshina, 2006; Vogel, 2011):

- One China. There is only one China in the world. Taiwan, Hong Kong, and Macau are an integral part of China. The central government is in Beijing;
- The coexistence of two political and economic systems. Socialism in mainland China and capitalism in Taiwan, Hong Kong, and Macau shall coexist and develop together over a long time;
- The high degree of self-government. After the reunification, Hong Kong, Macau, and Taiwan must become special administrative regions and will enjoy the right to a high degree of self-government;
- Peace talks. National reunification will be realized through peaceful contacts and negotiations.

The main milestones of China's opening-up policy in its first phase were the establishment of a vast network of SEZs, the return of Hong Kong and Macao to China's jurisdiction, and China's subsequent accession to the World Trade Organization.

During the first two decades of its "Reform and Opening-up" policy, China did not pay attention to the trade of services, primarily due to a certain lagging of the tertiary sector of the economy in the country as a whole. China did not, however, own a large merchant fleet, and had to put up with large deficits in transport services operations, with the vast majority of its export cargoes being transported to consumers on foreign ships. Only China's provision of construction services abroad generated a surplus. The situation changed radically after China accessed to the WTO (Rumbaugh & Blancher, 2004).

On 11 December 2001, after 15 years of negotiations, China became the 143rd member of the WTO and an important player in international trade. The country would benefit from free trade with the rest of the world, and the rest of the world would benefit from free trade with China, so it was beneficial to everyone (Shenshina, 2006; Sapir & Mavrodis, 2019).

During its accession to the WTO, China made serious commitments to international trade in services. The country's central government abolished 2,300 regulations and agency rules that were not WTO-compliant. At the same time, a series of regulations on access by foreign service providers to the banking, insurance, construction, and transport industries were adopted. China intensified international cooperation and improved its competitiveness in areas such as telecommunications and the Internet. The result was a surge in trade in services, which has seen China move from 12th place in the world to 2nd place in terms of volume. Between 2001 and 2017, China's services imports rose from $39.3 billion to $467.6 billion, with an average annual growth rate of 16.7%. The country's share of global services imports approached 10%. In the new services trade, China is strongest in telecommunication, computer, and information services. In contrast, it has a significant negative balance in the exchange of insurance services and, in particular, intellectual property rights fees (Lombardi & Malkin, 2017; Sapir & Mavrodis, 2019).

However, this is seen by China as evidence of a rapid increase in the technological level of its enterprises. Deeper cooperation between the mainland and Hong Kong in the services sector has also been put into practice in the Qianhai district of Shenzhen (which is part of the Shenzhen section of the Guangdong Pilot Service Zone). Specific mechanisms for cooperation in services trade have been established with Germany, Australia, and the UK. A special fund of 30 billion yuan has been set up to financially support regions and enterprises that develop innovative services (Lombardi & Malkin, 2017; Shenzhen Bay I-Park, 2018).

4 The PRC Regional Policy: From Special Economic Zones to Regional Innovation Systems

Another aspect of the "Reform and Opening Up" policy aimed at developing a market economy under the aegis of "Socialism with Chinese Characteristics" was the creation of the Special Economic Zones (SEZ). In 1980, the PRC Government decided to open four SEZs: Shenzhen, Xiamen, Zhuhai, and Shantou. They were removed from the country's planned-distributive economic system, and local authorities were vested with a significant amount of independence in regulating the economic issues. Enterprises with foreign capital received tax preferences, including a halved income tax rate. Since 1983 many privileges were extended to Chinese enterprises investing in SEZs, but they have not reached the level of foreign companies in terms of set and benefits at the beginning of 21st century (Chen, 2007).

The term "Special Economic Zone" is generic and conditional. According to the experts of the UN Center on Transnational Corporations, there are at least 30 different definitions of this concept. All of them reflect the duty-free or preferential treatment of import and export of goods in the zone, its certain isolation in economic, trade, monetary, and financial relations from the rest of the country, as well as a close connection with the world market (Yeung et al., 2009).

Due to the 1973 Kyoto's International Convention on the Simplification and Harmonization of Customs Procedures, a free zone (or "franco zone") is a part of a country's territory where goods are considered outside the national customs territory (the principle of "customs extraterritoriality") and therefore not subject to normal customs control and taxation. This definition shows that the freedom of an isolated part of the national territory is not absolute, but relative. This territory is free only insofar as the goods imported into it are exempt from customs duties and import tax which, under the national customs laws, apply to imported goods in other territories of the country. Thus, the local laws do not exempt the goods owners from complying with the relevant economic order, but only facilitate it (Fang, 1994).

4.1 Aims of SEZ Creation

The creation of SEZs was initiated by the CPC Central Committee in mid-1979. According to the plan, they were to become "open windows" to the outside world. They were supposed to bring foreign capital, high technology,

knowledge, and managerial experience, which, once adopted in the zone, would be used throughout the country. In addition, they were to become a testing ground for the market mechanism with the participation of all forms of ownership and the establishment of the most effective production relations with foreign firms. China's SEZs were used as a testing ground for the economic model that virtually all of China will use in the future. It is possible to distinguish the following features of China's SEZs (Yeung et al., 2009):

The separation of them from the customs border of the state and the establishment of a special regime of regulation of imports and exports of goods and services. As a rule, import of means of production, components, materials, and raw materials necessary for the production process, as well as consumer goods and food for sale within the country, is carried out duty-free in the territory of the zones. Export duties are usually also not levied in such zones. System of preferences and benefits provided to foreign investors, including (Wong, 1987):

- Foreign trade (reduction or cancellation of export-import duties, simplified procedures for foreign trade operations);
- Fiscal, related to tax incentives for specific activities. Benefits can affect the tax base (profit or income, property value, etc.), its components (depreciation charges, wage costs, R&D, and transport), the level of tax rates, issues of permanent or temporary exemption from taxation;
- Financial, including various forms of subsidies provided both directly – at the expense of budget funds and preferential government loans, and indirectly – in the form of low prices for public utilities, reduced rent for the use of land, etc.;
- Administrative, simplifying procedures for business registration, entry-exit regimes for foreign nationals.

The existence of a local, relatively separate system of management of the zone, empowered to make independent decisions on a broad economic spectrum. In the initial stage of 1979–1992, the creation of SEZs primary tasks were to attract foreign capital, advanced technology and management experience, export promotion, improve its structure, increase employment and training of skilled personnel, obtain additional foreign exchange earnings from the rental of land, premises, commercial and other services. The goals of China's SEZs can also be divided into economic, social, and technical ones. The economic goals included (Fang, 1994):

- Activation and expansion of foreign trade and foreign economic activity as a whole;
- Attraction of foreign and national investments into the economy;
- Rising the competitiveness of national production and its economic efficiency;
- Increase in exports and rationalization of imports;
- Enlargement foreign currency revenues to the national and regional budgets.

In addition to economic objectives, the establishment of SEZs was also intended to develop science and technology, as well as to set goals for the development of society such as (Vats et al., 2018):

- Creation of new jobs, growth of employment of the population;
- Education and training of skilled workers, engineers, economic and managerial personnel considering the use of international experience;
- Saturation of the national market with high quality goods and services for industrial and consumer purposes;
- Increasing the welfare and living standards of the population;
- Accelerating the development of backward regions by concentrating limited national resources within zones;
- Active use of the latest foreign and domestic technologies;
- Acceleration of implementation of R&D results;
- Concentration of scientific and technical personnel, including foreign ones, on priority directions;
- Attraction of experience and research achievements of scientific and technological centers and venture companies;
- Increasing the efficiency of used production facilities, in particular conversion facilities.

By providing tax, financial, foreign trade, and administrative privileges, the state encourages investment of both local and foreign capital. Thus, the creation of SEZs in China was a priority of the entire policy of "Reform and Opening-up" and achieved the following results: provided full employment for the labor force and was a destination place for new migrants; attracted investment, especially foreign investment; organized new industries in the zones whose products would be exported without infringing on existing local producers working for the domestic market. In addition, it gave an impetus to the development of economically backward areas, modernized obsolete equipment, got new "know-how", trained their specialists and workers in modern labor methods, and used their raw material resources to produce finished products. The creation of SEZs brought a fresh impetus to the industrial development of a particular territory and the country as a whole (Yeung, 2016).

Territories most favorable for the location of special economic zones, as a rule, had a border location, commercial seaports and, the main transport network (railways, highways, airports). But SEZ Shenzhen, was also possible in areas of new economic development that do not initially have a developed industry, industrial and social infrastructure, but allow the implementation of important long-term national programs.

The availability of skilled and cheap labor is an integral factor in the normal operation of SEZs. A prerequisite for the successful functioning of SEZs was the presence (or creation) of an effective zone management structure. The zone, being a local socio-economic system, should also have a local, relatively separate system of economic management, i.e. be out of the jurisdiction of branch ministries and central departments (Yeung, 2016).

The functions of SEZ administration include the regulation of the regional system of regional market infrastructure: commercial and municipal banks, stock exchanges, insurance companies, etc., as well as all issues of land use and nature protection. In addition, the SEZ administration registers joint ventures and foreign enterprises and licenses all foreign economic activities, as well as monitors compliance with the rules established for the zone, etc. Some SEZs allow the zone administration to register companies with foreign capital on a "one-stop-shop" basis, i.e., the investor does not have to consult different government agencies when setting up the company, but only the zone administration. The main task of the zone administration was to ensure favorable conditions for investors and the operation of zone enterprises (Vats et al., 2018).

An important role in the activities of zones was played by special public authorities, which supervise them. A steering group on SEZs and investment was formed within the State Council of the People's Republic of China. The

establishment and development of free economic zones took place in several stages (Yueng, 2016):

- The first stage (1978–1982) – the legal and organizational framework for attracting foreign capital was formed: a package of laws regulating taxation, technology transfer, labor relations, currency and customs regime, credit and financial support was adopted; bodies responsible for attracting foreign capital, control and regulation of foreign entrepreneurs based on a list of preferred sectors for foreign investment determined in 1982 were established. This stage allowed China to establish an appropriate institutional and legislative framework governing the entry and operation of foreign capital throughout the country.

- The second stage (1983–1989) was characterized by further expansion of China's territories open to foreign capital, consistent improvement of the contractual and legal framework for cooperation with foreign investors, and further liberalization of government policy in attracting and utilizing foreign capital. For instance, in the 131-square-kilometer-wide free economic zone of Xiamen with a population of 350,000, total investment from 1981 to 1989 had a value of $1.5 billion, including $500 million of foreign investment. In 1984, the institution of coastal open cities was created. This status was granted to 14 seaside towns, which constituted the so-called Techno-Economic Development Zones (TEDZ). This list includes many of China's major cities, namely: Dalian (Dalian), Qinhuangdao, Tianjin, Yantai (Chifu), Qingdao, etc.

- The third stage 1989–2000 was the improvement of the investment process. In June 1989, the State Council set priorities for foreign investment.

Joint venture projects oriented towards the following activities were seen as the most important (Yeung, 2016):

- Manufacturing products needed but not produced in the country;

- Manufacturing products for export;

- Investment in technology that can improve economic efficiency;

- Investments in energy, communications and transport, raw materials, electronic and household appliance production, and port facilities.

The greatest preferences have been granted to high-tech and new technology projects. These projects receive special tax and other incentives.

As early as 1988, the Chinese leadership adopted a master's program for the development of Chinese science and technology, which identified microelectronics and informatization, aerospace and fiber optics, genetic engineering and biotechnology, new energy-saving technologies, production of environmental protection and environmental protection equipment and medical equipment as priority areas for the development of knowledge-intensive industries. (Fang, 1994).

New and High Tech Development Zones, or analogs of American TechnoParks, are of strategic importance for economies. Their emergence as a major development driver amid China's streamlined economic structure is evidenced by the fact that their key economic indicators have risen by more than 40% on average annually since 1991 till 2016. (Yeung, 2016).

4.2 The four stage 2000–Today

By the early 2000s, China was becoming a world leader in the development of various types of SEZs. The number of High Tech Development Zones reached more than 150 by 2018, and more new service zones were opened to develop certain sectors of the regional economy.

At the present stage, SEZs are becoming part of new regional conglomerations – Regional Innovation Systems (RIS) or urban industrial clusters in the Bay Areas. Industrial clusters are another way of organizing productions according to the geographical principle (Lenge, 2019).

A cluster is a network in a certain area, where the proximity of companies and institutions provides certain forms of community and increases the regularity and influence of interactions. At the same time, a group of geographically neighboring interconnected companies and related organizations operates in a certain area and is characterized by a common activity. Clusters contain many related industries and structures, including public and private institutions – such as universities, standardization agencies, think tanks, and trade organizations – all of which are important for ensuring competition (Sonobe and Otsuka, 2006).

City clusters have been part of the PRC's urbanization strategy since the 2006 National Urban System Plan. They were included in the 2014–2020 National New-Type Urbanization Plan and China's 2016–2020 Thirteenth Five-Year Plan. The PRC's key objectives were to improve the distribution and layout of urban areas and population, as well as the management of natural and economic resources, by organizing city cluster development along east-west and north-south corridors. The plan called for a proper industrial

division of labor, the coordination of planning and infrastructure, ecological conservation, and environmental improvement to achieve integration and efficient development within city clusters (Groff and Rau, 2019).

The industries of most cities in the coastal development regions of China have been built according to the cluster principle, i. e. in terms of optimal placement of production. According to the 2017 outline plan for the development of the GBA region, each of its cities by 2035 will be an ″industrial-innovative cluster″ or the Regional Innovative System (RIS) (ODP, 2019).

Moreover, the RISs in China are organized according to the ″quintuple helix″ model (Carayannis and Campbell, 2010). This dynamic model of socio-economic interactions arises as a result of the evolution of the economy and society. According to this concept, in the industrial era, the interaction between institutional sectors –business, government, and science – was linear, and in the modern post-industrial economy it resembles the linking of DNA spiral structures. This allows the players to adopt and retain the ″genetic traits″ of each other. The quintuple helix is managed through a regional partnership mechanism for economic development based on innovation, environmental sustainability and collaboration between government, industries, science, and civil society The management process is complex, as representatives of business, science, society, and government who are involved in the cluster and their interests, must also take into account the state of the environment and understand the impact they have on it. Clusters become successful when all the participants manage to combine their interests with the goals of cluster development with minimal harm to the environment (Song, 2013).

By supplying competitive products to the global market, China's RIS becomes a point of growth, influencing both the economy of the region and the country as a whole. In the ″quintuple helix″ model, the state plays the role of regulator, defining plans and rules for interaction between all elements of the ″helix″ – the state itself, business, scientific and educational structures, civil society, and the natural environment (Song, 2013).

4.3 China SEZ Typology

4.3.1 Special Economic Zones

The development of urban industrial clusters is now an integral part of the Chinese development plans. Industrial clusters are an element of the Bay regions and development belts. Thus, the Chinese zoning policy is entering a new stage of development. In the PRC there is a wide variety of types of SEZs, each of which has its specifics, conditioned by many factors and

their combination in each case. Such factors include location, size of the territory in which the SEZ is located, availability and quality of productive and other resources, peculiarities of natural, economic, and other conditions and tasks that the state set for the SEZ during its creation, functions which it has delegated to it for solving the set tasks, etc. China's SEZs are classified according to various criteria (Yeung, 2016).

Four SEZs were first established in China in 1978–1982: Shenzhen, Zhuhai, Shantou (Guangdong province) and Xiamen (Fujian province), and in 1988 they were joined by Hainan SEZ, which was officially proclaimed the fifth SEZ. An important driving force of the SEZs was the introduction of market regulation principles to them. Each of these SEZs were given the right to adopt its legislation on economic matters, independent of the provincial government. All zones were granted a reduced corporate tax rate of 15 percent (as against a 33 percent national tax rate), duty-free importation of goods for export production and export abroad, and preferential rental of land and infrastructure. These zones were restricted areas that required a special permit to enter. The main distinguishing features of the SEZs were (Yeung et al., 2009):

- A differentiated ownership structure, with enterprises with foreign capital taking the lead;
- Domination by market regulation;
- Enterprises production oriented towards exports;
- Foreign investors have privileges in payment of corporate taxes;
- Foreign investors have preferential terms for corporate tax payments; the procedures for obtaining visas and permits have been simplified.

The state granted the SEZs considerable autonomy and control over their foreign trade activities. Initially, in January 1979, the state-owned company China Merchants set up a special zone in Shekou (Nanshan) to attract Hong Kong businessmen, and in March 1980, the central authorities officially approved the creation of the Shenzhen SEZ. The Shenzhen SEZ originally covered the urban areas of Luohu, Futian, Nanshan, and Yantian, but in July 2010 it was expanded to other areas, and has increased almost five times –from 396 to 1.953 km^2 (Zhu & Lin, 2004).

The Shenzhen SEZ is predominantly industrial, developing nuclear power, electronics, engineering, high-tech industries, the chemical industry, and the development of oil deposits in the South China Sea. The annual GDP growth rate exceeded 37% and the GDP of Shenzhen SEZ reached 1 trillion CNY

in 2017. For enterprises based in the SEZ, there is a preferential income tax rate and so-called 5-year ″tax holidays″ with full or partial exemption from this tax (Vats at al, 2018).

The city of Zhuhai was also originally founded in 1978 as SEZ and received city status in 1979. The Zhuhai SEZ specializes in the light and food industries, and the production of building materials, household appliances, and tourism are also of great importance. More than 4.980 enterprises with foreign investments are operating in the zone. 80% of the zone's capital comes from Hong Kong, Macau, Taiwan, and Singapore. In recent years, the Zhuhai Administration has been transferring all the plants and factories from residential areas to specially created technology parks, which has had a very positive effect on the ecology of the resort city (Bret and Chad, 2018).

The Shenzhen SEZ, attained official status in August 1980 with the enactment of the Guangdong Provincial Special Economic Zone Ordinance and 40 years of economic growth has brought it far ahead of even the biggest economic powerhouses such as Beijing, Tianjin, Shanghai and the provinces of Shandong and Fujian.

4.3.2 Open Coastal Export-Production Cities

In 1984, it was decided to ″open″14 port cities on the coasts of the Yellow Sea, East China Sea, and the South China Sea. They were Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, and Beihai. These territories with a population of more than 20 million comprise the entire coastal belt of the country and extend well into the interior of the mainland. These 14 cities, opened to the world market and the internationalization of production, were not distressed areas, to begin with. They gave 23% of China's total industrial production, and their share in the country's exports reached up to 40%. This type of SEZ was established in the industrialized belt of China (Yueng, 2016).

Open cities were the second-generation zones. They were the result of the evolution of SEZs, where not only capital but also goods were brought in, not only in trade but also in manufacturing. Export-production open cities were created on the territory with a special customs regime, where export or import-substituting products were produced. These zones enjoy significant tax and financial benefits. The distinctive feature was that by using preferential currency and financial and legal regimes, the state ensured the development of the most priority industries on the territory of the zone or stimulated industrial export production in depressed areas, attracting foreign currency or investments from local authorities for this purpose (Yueng, 2016).

This created conditions for more efficient use of local raw materials, semi-finished products, the introduction of modern methods of production management, and the training of personnel with appropriate qualifications, which ultimately contributed to a more rapid socio-economic development of other regions and the country as a whole. Guangzhou, one of the open coastal cities, was the first commercial port in China opened to foreign trade. Over history, the city played an important role in world trade. Currently, the city has more than 100,000 retail chains, consisting of large department stores, wholesale and retail self-service stores, markets, etc. Guangzhou is one of the three financial centers of China, and the second city in the country in terms of the number of foreign banks operating. Besides is a city with a strong industrial base, a developed service and consumption sphere, and a center for coordinating the integrated development of the national economy. The Canton Fair, held twice a year in the city, is the most important event in the world of commerce, the world's third largest industrial fair in terms of the number of deals made (HKTDC, 2022)

4.3.3 Hi-tech Development Zones

Science and technology (S&T) development zones now operate in many countries. In the USA they are called technoparks, in Japan – technopolises, in China – Hi-tech Development Zones (HtDZ). HtDZs refers to the third generation of special zones in China. They began in the 1990s and 2000s. They were specially created with the state support around the big science centers. They concentrate on the national and foreign R&D, R&P firms, enjoying a unified system of tax and financial incentives. Depending on what prevails in the economic structure of the HtDZ, there are three types (Yu, 2011):

- An innovation center, which is an economic structure located within a small area and designed primarily for a small, newly established company;
- Science or technopark. It is a structure with a sufficiently large territory accommodating knowledge-intensive firms of different sizes and stages of development, which allows deploying small-scale production based on the scientific and technical developments of the local research centers (universities);
- Research park. This is a structure in which scientific and technological innovations are developed only to the prototype stage. Such parks bring together industrial companies, and research and development institutions, with the priority development of the latter.

There are currently more than 150 HtDZs in China. Characteristically, S&T zones in China are often formed as innovation centers of established export-production zones, which are already sufficiently developed and require reorientation to the production of knowledge-intensive products (Lenge, 2019).

Shenzhen Technopark is an example of how to create innovative structures based on the specifics of national conditions. At the time of the establishment of the Technopark in Shenzhen in 1996, there was neither a leading university, nor a research center, nor a developed area of innovation support, nor highly qualified personnel. In 2001, the municipality allocated a land plot of 11.5 square kilometers in the Nanshan district and 100 million yuan for its creation. The leading Chinese institutions of higher education – for example, Tsinghua University, as well as world known companies and firms (Epson, Thomson, Siemens, etc.) placed their representative offices there (Du, 2020). On the other hand, Hong Kong was near to its sources of capital and information. In addition, the technopark was guaranteed scientific and technical support from the Academy of Sciences of China, one of its founders. As a result, the required infrastructure of the technopark was created in a short time, and thanks to the conditions of the SEZ, foreign capital was attracted (Chen & Ogan, 2016).

In 2002, the industrial output value of the city's high-tech industry reached 71.9 billion yuan (US$10 billion), equal to about 20 percent of the city's total industrial output. In 2011, the industrial output value of the Shenzhen Hi-Tech Industrial Park reached 405.4 billion yuan, 40 times its value when it was founded in 1996. It yielded 24.4 billion yuan of GDP and 4.3 billion yuan of tax revenue per square kilometer in 2018, the greatest share among its counterparts in the country. Today the Shenzhen Hi-Tech Industrial Park has expanded from its core location in Nanshan District into an area of 159 square kilometers encompassing five separate locations, including the Pingshan, Longgang, Bao'an, and Longhua districts. The Nanshan Technopark is intended to develop into the main comprehensive national-level science center of the Greater Bay Area. The expanded Shenzhen technopark is also going to be a world-leading high-tech industrial park, an important base for high-end industries, a key area for innovation, and a key node of the Guangzhou-Shenzhen-Hong Kong-Macao Innovation Corridor (BMA, 2018) that by year 2019 includes several H-Tech zones, each one with specific industries (See Table 5).

Table 5: Hi-Tech Development Zones located in the Greater Bay Area

Name	Main industries
Shenzhen High-Tech Development Zone	Electronic information Opto-Mechatronics integration Biological medicine
Guangzhou High-Tech Development Zone	Electronic information Biological medicine New materials
Zhongshan Torch High-Tech Development Zone	Electronic information Biological medicine Equipment manufacturing
Foshan High-Tech Development Zone	Equipment manufacturing Intelligent household appliances Auto parts
Huizhou Zhongkai High-Tech Development Zone	Mobile Internet Flat-panel display New energy
Zhuhai High-Tech Development Zone	Electronic information Biological medicine Opto-Mechatronics integration tech
Dongguan Songshan Lake High-Tech Development Zone	Electronic information Biotechnology New energy
Zhaoqing High-Tech Development Zone	New materials Electronic information Equipment manufacturing
Jiangmen High-Tech Development Zone	Electrical and mechanical Electronics Chemicals

Source: HKTDC (2022).

4.3.4 Service Industry Cooperation Zones

Another type of SEZ in China are service zones or modern industry cooperation zones. These highly specialized zones, which began to appear after 2010, belong to the later, fourth generation of SEZs. They include areas with preferential treatment of business activities, specializing in the provision of various kinds of services – financial, information, tourism, and others, most often business. Service zones include financial centers, banking, and insurance services, as well as offshore zones and tax havens, which attract

entrepreneurs with their favorable financial and monetary regime, high level of banking and commercial secrecy, and loyalty of the state regulation. It replaced the previous "low-cost land policy" of the more traditional industrial zones and is used to explore policies for modernizing Chinese businesses. The Service Zones are seen as a blueprint of further reform throughout China. Unlike other types of SEZs, they can experiment with financial models and attract investment, and are located in areas with geographical advantages for trade e. g. major seaports and international airports. Each of the locations has not been chosen randomly, but serves a specific purpose (SZQH, 2014):

- Choosing a virtual office instead of a real one;
- Procedures registering in Service zones are much quicker and easier;
- Less – or no – (import/export) taxes;
- Easier conversion from RMB to foreign currencies;
- Special customs monitoring system:
  - Detailed customs clearance is only needed in a later stage;
  - Faster custom clearance of goods;
  - No import tax when imported into the zone.
- Bonded warehouses;
- Broadening of investment horizons.

The Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone or Qianhai Special Economic Zone is an experimental commercial development in Shenzhen. It is at the forefront of business in China and has been set up to encourage foreign investment in modern industries such as science, finance, high-tech manufacturing, and modern logistics. First officially approved in 2010, the zone was established to improve the interaction between mainland China and Hong Kong, with a specific focus on the financial, logistics and IT services sectors. The SEZ covers almost 15 square kilometers comprising almost entirely land reclaimed from the sea and lies within the city limits of Shenzhen. As one of China's most economically productive cities, Shenzhen has the highest GDP per capita, the highest volume of overseas exports, the highest number of patent applications, and the highest number of patents per capita of any major city in China. The zone was scheduled to be completed by 2020, offering a range of incentives and preferential financial policies to encourage foreign investment (SZQH, 2014).

According to the Qianhai administration's plans, as a pilot district for mainland China-Hong Kong cooperation and innovation in the service industry, Qianhai assumes four functions (Lenge, 2019):

- Facilitating innovation in the modern service industry;
- Becoming a center for modern services and modern service development;
- To be a pilot area for closer cooperation between Mainland China and Hong Kong;
- Facilitate the industrial reform and sustainable economic development of the Pearl River Delta.

Table 7: Service Zones located in the Greater Bay Area

Name	Year Established	Main industries
Guangzhou Nansha New Area	2015	Shipping industry Logistics Financial industry International trade High-end manufacturing
Shenzhen Qianhai Development Zone	2014	Financial industry Modern logistics Information services Technology services
Zhuhai Hengqin New Area	2015	Tourism industry Finance services Cultural and education industry Hi-tech industries

Source: HKTDC (2022).

In June 2012, the State Council approved a series of special policies to make the Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone an attractive area for foreign investment. Most of the policies fall within the framework of the China-Hong Kong Closer Economic Partnership Arrangement (CEPA), the most prominent of which were the 15% preferential corporate tax rate. Eligible professionals working in Qianhai were

exempted from personal income tax. Qianhai was supported in its efforts to establish a parent equity investment fund. Relevant policies and measures were formulated to attract a professional and international workforce. As a modern service industry cooperation zone, Qianhai focuses on finance, modern logistics, information services, technology services, and other professional services (See Table 7) (Lenge, 2019).

4.4 Bay City Clusters or Regional Innovation Systems

The development of ocean transportation, especially since the container era began in the mid-20th century, has promoted the development of industrial clusters in the coastal areas. The industrial port-cities represented by Hamburg and Tokyo have risen rapidly, and economic activities have expanded to surrounding areas.

In the course of unfolding industrialization, port cities acquired the role of industrial and logistic hubs. Since the 1980s, under the rapid development of economic globalization based on industry and foreign trade, new industries began to develop. In addition to industry, port cities began to develop service sectors, finance, law, insurance, advertising, and design. Coastal cities became not only logistical intermediaries of large industrial enterprises, but also service and financial centers, and exhibition and demonstration zones. Trade missions of international organizations began to grow there (Zhu, 2019).

At present, 60% of the global economic aggregates are concentrated in bay regions, 75% of large cities, and 70% of industrial capital and population are concentrated in coastal areas within 100 kilometers from the sea. The largest part of the world's most developed cities are located in the Bay Areas. Among the top 50 global megacities, port cities account for more than 90%, including New York, Tokyo, Sydney, Los Angeles, San Francisco and Hong Kong (Martinez et al., 2007).

Natural feature of the bay regions is the high degree of openness; the coastline cities tend to attract a large number of people. The high degree of coastal cities openness tends to take the lead in the development of cultural diversity, attracting a large number of migrants, and forming an open and inclusive immigration and cosmopolitan culture that is different from the general inner areas. Openness has fed back innovative development. E.g. in the New York Bay Area, foreign residents come from more than 150 countries and regions around the world, accounting for about 40% of its population (Creel, 2003).

In 1998, Woo Chia-wei (Wu Jiawei), President of the Hong Kong University of Science and Technology, proposed the term "Hong Kong Bay Area" (also known as the "Shenzhen-Hong Kong Bay Area"). The term "Bay Area"

was previously used in relation to industrial development areas of Tokyo or San Francisco, and for the first time was applied concerning the development areas of China (Woo, 1998).

However, as a state strategy of the PRC, the systematic development of the economies of the urban clusters in the bay areas has been outlined recently. In the 19th National Congress in 2017 it was proposed to implement the new government plan, the modern regional policy concept based on the development of three major bay areas of China: Guangdong-Hong Kong-Macao Greater Bay Area, Hangzhou Great Bay Area, and Bohai Economic Rim Bay Area (SCPRC, 2019).

China's urban policy is currently based on modern inclusive urban planning trends. Some of these are also known as "Delta Urbanism" and "Bay Area Urbanism" (Nijhuis et al., 2020).

The bay regions of China are already Regional Innovation Systems (RIS) – the testing grounds for emerging high-tech and service industries. These include information and communications technology (ICT), 5G, artificial intelligence, cyberspace science, biotechnology, new materials, environmental technology, and marine technology. The Governments of Bay Regions also cultivate breakthrough innovations by collaborating with industry players in areas such as broadband technology, advanced Chinese medicine and bioinformatics, electric vehicles, LED technology, materials science, and various "green" technologies. As for the services market, the Bay Regions focus on financial services, conventions and exhibitions, logistics, IT and high-tech services, outsourcing, creative industries, headquarters services, and tourism (KMPG, 2020).

There is a consolidation in the regions of research and development (R&D) projects, hi-tech development zones, technoparks, and laboratories. Currently, the concentration of hi-tech technologies, innovation and research enterprises in the Greater Bay Area is one of the densest in the world. There is a continuous international research integration between companies, technoparks and universities: Shenzhen Technopark is China's biggest Software Park with more than 1.000 firms which have set up operations there, including Tencent, MCM, Kejian, Oaking, Guanri, Liming, Aspire-tech and many other IT developers. Shenzhen Virtual University Park attracts more than 50 foreign and domestic universities and supplies a talented workforce in the innovation sector (Shenzhen Bay I-Park, 2018).

Hangzhou also holds the leading position in innovation development. In 2017, Linkedin released the first "China Workplace Globalization List". Hangzhou ranked first in the country in terms of the relative amount of talent inflows. In the domestic competition for talent, Hangzhou has also ranked first for many years. In terms of blockchain and artificial intelligence tech-

nologies, Hangzhou has the world's largest number of patents (Zhu, 2019).

Binhai New Area of Tianjin is the main northern RIS. By the end of 2017, more than 464 municipal-level and above research centers, including 111 key laboratories and 241 technological centers of major companies, had been established in the area. The size of its intelligent industry was expected to reach 50 billion RMB ($7.84 billion), and also fulfill its goal of achieving more than 2.000 independent intellectual property rights by 2020 (Wang and Zhao, 2017).

China's Great Bay RIS are the main parts of China's inter-regional innovation cooperation network. As the result of the establishment of a relatively sound market mechanism, enterprises of these urban clusters present strong vitality and can actively cooperate and communicate with other regional innovators (Pan et al., 2020).

5 The Role of Hong Kong in the GBA formation

Hong Kong has been of fundamental importance in the formation of the regional innovation system of the Greater Bay Area where it is included. The colonial territories of Hong Kong and Macao are neighbors of Guangdong province and they always have had a very close relationship with an ongoing movement of population from mainland China to them, as well as an increased economic integration. Hong Kong in 1997 and Macao in 1999 returned to the jurisdiction of the PRC after negotiations, with the compromise that they retain self-government during at least 50 years – ″one country, two systems″ . The Sino-British Joint Declaration (1984) and The Basic Law (in effect since 1 July 1997) were the framework to the return. Hong Kong has become a service crossroads connecting China with the rest of the world, and this role is key to the viability of the project of the Greater Bay Area. All these issues will be developed in this chapter.

5.1 The Rise of Asian Tigers

The Pearl River Delta region in Guangdong province has historically been a crossroads of trade routes from Southeast Asia and India to Europe. After the Qing dynasty came to power in China in 1644, a policy of restricting ″free seas″ and levying tribute on merchant ships began, and Guangzhou was officially designated the first Chinese port open to international trade and levying duties to the state treasury since 1700, the number of merchant ships arriving in Guangzhou grew annually from about a dozen in 1720 to over a hundred in 1840 (Van Dyke, 2020).

Over time, the British East India Company (EIC), founded in 1600, gained an increasing monopoly among other foreign traders. The British found a way to exchange Bengal opium for Chinese silk and tea, which led to confrontations with the local authorities and resulted in the Opium Wars. After the First Opium War, which China lost, the British Empire took possession of Hong Kong Island in 1842 under the Treaty of Nanjing. A year later, Victoria Town was established and the island became an official colony of the Crown, as so-called ″Overseas Territories″ . In 1860, following the defeat of China in the Second Opium War, the territories of the Kowloon Peninsula south of Boundary Street and Stonecutters' Island were also ceded to Britain in perpetuity under the Treaty of Beijing. And in 1898, Britain leased the adjacent territory in the north of the Kowloon Peninsula and Lantau Island from China for 99 years, which became known as the New Territories. At

the same time, Hong Kong was declared ″Porto-Franco″ , a duty-free territory to facilitate the British Empire's role as a cargo trans-shipment base in Southeast Asia. The Guangzhou – Kowloon railway, which opened in 1910, became the first ″Mainland – Island″ land connecting route (Gentle, 2012; Van Dyke, 2020).

The British educational system was also introduced in Hong Kong. ″Modern ideas″ were rapidly spreading there. In the 1880s Sun Yat-sen studied in Hong Kong and in 1894 he became the leader of the Chinese Renaissance Society founded in Kowloon and soon transformed to the United League（同盟会 Tongmenghui）, which was later renamed the Guomindang (国民党 or Kuomintang) and led the Xinhai Revolution of 1911. Following the Chinese Civil War and Mao Zedong's rise to power, the Guomindang government fled China to the island of Taiwan, which was also a Japanese colony from 1895-1945. But also mainland Chinese who supported the Guomindang and opposed the Maoist government fled to Hong Kong and at times several flows of migration continued into the 1990s (Chang, 1992).

On 6 January 1950, Britain, in furtherance of its economic interests, officially recognized the People's Republic of China (PRC) as the government of China and barred the government of the Republic of China from participation in the San Francisco Treaty (1951) that posed the question of what government would remain of Taiwan. However, in 1957, British Prime Minister Harold Macmillan entered into a secret agreement with the United States whereby the USA agreed to defend Hong Kong with the British as a ″joint defense article″ in the event of an attack by the PRC. In exchange, the British promised not to seek the PRC's membership in the United Nations, leaving Taiwan's seat in charge. However, in 1971 a United Nations General Assembly resolution was supported by the British and passed, recognizing the PRC as the legitimate government of China and a UN's member. Later negotiations between Britain and the People's Republic of China to hand Hong Kong over to the PRC, which ultimately decided the future of Hong Kong as part of the PRC, but not the Republic of China's (Chang, 1992).

However, the pro-Taiwan camp has been one of the main political forces in Hong Kong for quite some time. Operations against the Communists by the pro-nationalists in Hong Kong were particularly intense in the 1950s and 1960s, and the island was always the ″focal point of opposition forces″ and the center of political struggle between the pro-nationalists and democrats (the so-called ″Right″) and the pro-communists (the so-called ″Left″). Also until 1997, it was not uncommon to see flags of the Republic of China on the streets of Hong Kong (Tong, 2020).

The process of returning the territory of Hong Kong to Chinese jurisdiction was conceived as the first stage in the unification of the PRC and Taiwan.

Politically, Hong Kong is the territory through which information transit between the PRC and Taiwan takes place. Prior to 1997, Taiwanese-owned social organizations were located in Hong Kong trying to solve problems of cultural, economic, and international interaction. There was also an office of the Guomindang on Hong Kong territory. Taiwan carried out vigorous anti-communist propaganda in Hong Kong, advocating the sovereignty of the island under the slogan of a ″China-free Hong Kong″ . In 1985, the slogan ″Xianggang duli″ (香港獨立 literally: independent Hong Kong) was promoted by Taiwan's representative office in Hong Kong. According to the Taiwanese side, the PRC was trying to forcibly return the island under its sovereignty without the consent of the Hong Kong people. For the PRC, the issue of Taiwan-Hong Kong relations has also been an open question for many years (Horton, 2019).

Deng Xiaoping said in a speech in the fall of 1984 that once Hong Kong returns to Chinese jurisdiction, Taiwan will not be curtailed in its rights. It would also retain the right to maintain an anti-communist stance, but any provocative action in Hong Kong after 1997 would be strictly prohibited. Deng Xiaoping believed that ″an imbalance in Hong Kong would lead to an imbalance in the PRC; it would not be appropriate to divide China into two political parts″ (Belyaev, 2020).

During the China-United-Kingdom talks, the question of how Hong Kong should interact with Taiwan came into sharp focus. The plan was for Hong Kong to help keep the PRC and Taiwan connected. During the discussion, the issue of preserving organizations that belonged to Taiwan after 1997 came up once again. However, during the talks, both sides decided that Hong Kong and Taiwan should stop interacting, so as not to exacerbate the situation in the future with the build-up of new social problems. The Beijing side indicated that it will take necessary measures to prevent cultural, economic, and other interactions between the two sides. In response to this announcement, by the end of 1984, the Taiwanese representatives expressed their desire to continue fighting for the rights and freedoms of Hong Kong citizens. In addition, they guaranteed to create conditions for Hong Kong immigrants who wished to enter Taiwan. Special economic incentives were also introduced to attract capital from Hong Kong to its territory. In other words, Taiwan has promoted the self-government of Hong Kong, and also guaranteed considerable support from its side (Bush, 2020).

Despite the lack of support from Taipei, the PRC authorities did not change their position. On the contrary, they realized that in the absence of an interface with Hong Kong, which plays a key role in industry and agriculture, Taiwan would suffer economic collapse. The tipping point was that in early 1984, the only party (represented by the US) that had previ-

ously supported Taiwan took the position of the PRC. A State Department spokesperson said in an interview that America was treating the issue of Hong Kong reunification as only a British-Chinese issue. The US side considered it unwise to interfere in the issue. Moreover, the spokesperson said that ″this smooth process of Hong Kong's transition to Chinese sovereignty is a good model for the people of Taiwan″ . Nevertheless, the Taiwanese government decided to take a wait-and-see approach by not taking action to move all Taiwanese institutions out of Hong Kong and not removing Taiwanese citizens from its territory (Belyaev, 2020).

After 1949, direct flights between Taiwan and mainland China were banned; so many passengers were ferried to Taiwan via Hong Kong until 2003 when flights across the Taiwan Strait were allowed. In 2018, some 1.7 million Taiwanese citizens visited Hong Kong, which ranks third behind Japan (4.8 million) and mainland China (4.1 million) in the list of tourist destinations chosen by Taiwanese (Bush, 2020).

Hong Kong and Taiwan, with continuous economic infrastructure and education development since the second war, are among the ″Four Asian tigers″ . ″The Four Asian Tigers″ or ″Four Asian Dragons″ are the popular terms used to refer to the developed economies of Hong Kong, Singapore, South Korea, and Taiwan. These countries were known for maintaining exceptionally high GDP growth rates (above 7 percent a year) and rapid industrialization between the early 1960s and 1990s. By the 21st century, all four developed into advanced economies specializing in areas of competitive advantage. For example, Hong Kong and Singapore became world international financial centers, while South Korea and Taiwan were world leaders in information technology production. All of them also had a model of production for exportation. Their economic success stories have served as role models for many developing countries, especially the so-called ″Tiger Cub Countries″ – Indonesia, Malaysia, Philippines and Thailand (Dangayach & Gupta, 2018).

5.2 Migration flows from China to Hong Kong

There was little cooperation between China and the United Kingdom until the late 1970s. The only contact was when issues relating to migration flow or decolonisation were discussed. However, the influx of refugees and migrants from different cities in China, as described earlier, increased every year. After the Communist Party came to power, the founding of the People's Republic of China and the so-called ″Fall of the Bamboo Curtain″ , Hong Kong's population grew by almost a million people in 1949 alone (Wong, 1992).

″Hong Kong experienced an increase in population due to continuous mi-

gratory waves. The 33,100 inhabitants of 1851 increased to 119,300 ten years later, and in 1901 there were already 297,200 inhabitants, which included the population of the New Territories leased to China in 1898. During the 1910s the population increased at a very high rate, from 366,100 inhabitants in 1911 to 625,200 in 1921. In 1927 it reached a peak of 977,900, and after the crisis of 1929 its population dropped slightly to 849,800 in the 1931 census. In 1938 Hong Kong exceeded 1 million people for the first time, and by 1939 the population was already 1.28 million. The population continued to increase until the time of the Japanese invasion (1941–1945) which caused a dramatic loss of population that according to estimates was approximately one million people, falling from 1.6 million in 1941 to 600,000 inhabitants in 1945. After the end of the Japanese occupation, the population recovered very quickly and by 1950 it had almost two million people. Since then it has grown at an average of approximately one million people per decade, reaching 7.2 million in 2001″ (Beltrán Antolín, 2003, pp. 17–18).

Many of the refugees arriving in Hong Kong remained there permanently. By the seventies, the inflow of migrants amounted to more than twenty thousand residents a year, with an equal number of refugees. The authorities in Hong Kong were worried about these population inflows, stating that those caught at the border will face immediate deportation. However, those who entered the colony were allowed to remain. After 1978, the situation worsened and migration increased (Wong, 1992). Immigration from the PRC to Hong Kong was rampant and migrants lived in rather poor conditions, often without jobs. They had limited rights and were subjected to discrimination in the 1980s. Chinese refugees were employed in industry, construction, and the service sector. They often had no political interest in the situation between Hong Kong and the PRC. Besides, Hong Kong offered them the opportunity to go to North America or Europe (Burns, 1987). In addition to irregular refugees, there were also legal immigrants. The legal immigrants had a rather negative attitude towards the changes taking place, being critical of the PRC government (Burns, 1987).

The fact that a large percentage of the refugees were ordinary workers who had no qualifications prompted the Hong Kong authorities to voice their displeasure with the PRC and demand stricter border controls. In October 1980, Hong Kong introduced special identity cards for all Hong Kong residents over the age of sixteen. This enabled the colony authorities to legally deport irregular refugees back to the PRC. The card was required to be carried everywhere and routine inspections were carried out. From 1981–1984 between 10,000 and 18,000 irregular migrants were deported every year (Wong, 1992).

The authorities considered that migrants from the PRC were unskilled

laborers, poor people who could create instability in society. Nevertheless, until the eighties, Hong Kong could not keep out refugees, as the British administration considered them to be people who had been ″overtaken by the totalitarianism of the Chinese character″ . The Chinese, in turn, by relaxing and tightening border controls, were able to influence the situation in Hong Kong. In other words, the situation in Hong Kong society was partly in the hands of the PRC (Burns, 1987).

Since 1997, more than 760,000 people, most of them women, have moved from China to Hong Kong under the family reunification program. In 2003, the Hong Kong Special Administrative Region Government began to implement a series of measures to filter the flow of migrants, the first of which was The Admission Scheme for Mainland Talent and Professionals and Capital Investment Entrant Scheme, and three years later it was joined by the Quality Migrant Admission Scheme to attract skilled migrant workers to Hong Kong. Two years later, in 2008, the Immigration Arrangements for Non-local Graduates scheme was introduced, and in 2018 the Technology Talent Admission Scheme was added to the four already tested schemes to attract IT and technology professionals to Hong Kong. From 2003–2017, more than 260.000 Chinese came to Hong Kong under these schemes, as the following chart illustrates (Lam & Fong, 2022).

However, the number of official migrant workers from China to Hong Kong is very small compared to the daily passenger traffic between Hong Kong and Shenzhen. According to the Hong Kong Immigration Office, about 250,000 people crossed Hong Kong's land borders daily in 2018, and during the holiday season, those numbers doubled to 450,000 arrivals a day. At the same time, 80 percent of the arrivals were PRC passport holders. The Lo Wu Passenger Terminal was the busiest, with about half of all arrivals arriving in Hong Kong by land. The peak number of passengers crossing the Lo Wu Pass was 250,000 per day.

According to the Hong Kong Tourism Bureau, nearly 80 percent of all visitors to the island since 2013 come from mainland China. This trend continued in 2019 as well, with nearly 32 million mainland Chinese visiting Hong Kong from January to July, four times the number of visitors from the rest of the world. Visitors from mainland China also spend significantly more in Hong Kong than visitors from other countries. For example, in 2018, an overnight visitor from mainland China spent an average of HK$7,029 (US$896), a quarter more than a visitor from other countries. In 2018, 65 million tourists visited Hong Kong – nearly nine times its population of 7.5 million, a figure that outpaced even New York City. According to the Peterson Institute for International Economics, more than 44 million visitors from the mainland added HK$56.8 billion (US$7.24 billion) to Hong Kong's

economy in 2017, accounting for 2.2 percent of the city's 2017 GDP (Huang, 2019b).

5.3 Sino-British Joint Declaration and The Basic Law

The PRC government, despite United Kingdom attempts to renegotiate the terms of the 1898 treaty, made it clear that the timely restoration of sovereignty over the entire territory of Hong Kong – whose lease would expire by 1997 – was of paramount importance. In March 1972, when the PRC regained its membership in the UN, a memorandum was submitted to the Decolonization Committee, which was that Hong Kong was part of the Chinese territory occupied by the United Kingdom. The PRC rejected any independence of the territory, recognizing only reunification with the Chinese as the best possibility of resolving the existing dispute (Ngok, 1997; Shenshina, 2006).

The late seventies demanded final decisions on the Hong Kong issues from both sides, as there were some twenty years left before the end of the treaty. However, the necessary solution, based on publications in the Hong Kong media, had only been agreed upon by May 1982. In 1979, Murray MacLehose (Governor of Hong Kong) attempted to renew the lease on the colony, but to no avail. The PRC considered that the territory in question was truly Chinese and was to be returned under Chinese sovereignty. Despite this, the exact time of restoration had not yet been set. Negotiations began with a meeting in September 1982 between British Prime Minister Thatcher and Deng Xiaoping. During the talks, it was decided to hold bilateral consultations, which were divided into two phases (Shenshina, 2006).

The first was held in the PRC with the help of the British Embassy and the Chinese Foreign Ministry; the second began on July 12, 1983. During these negotiations, the Chinese delegation gave no objection to the continued existence of the British administration in the colony. In parallel with these negotiations, the PRC began activities to strengthen ties with various circles of Hong Kong society. In February 1983, many Hong Kong residents became members of the National People's Congress (hereafter, NPC) and the People's Political Consultative Conference. Frequent visits by Hong Kong delegations to the Chinese capital began to take place, intending to clarify questions about the future of Hong Kong.

In the second phase of the Sino-UK negotiations, more controversy began to emerge. The Chinese press on the subject ironically emphasized that "the first stage was useful and productive, the second was merely useful, and the third was done" . There was a perception that signing a general agreement was impossible. But in mid-August Zhao Ziyang responded to questions

from Japanese correspondents by announcing that a Chinese restoration of sovereignty over Hong Kong would take place on the first of July 1997. Hong Kong trade union organizations and the media supported the position on the further development of the "Chinese scenario". Despite this, there was still an increase in emigration from Hong Kong and an exodus from the local capital. Residents of the colony, fearing for their savings, actively began to convert them into US dollars. The dispute between the two parties (the British and Chinese) caused the Hong Kong dollar to lose value, leading to increased prices and social unrest. This led to demonstrations against rising prices (Shenshina, 2006).

By the end of September 1983, the Hong Kong dollar had matched the US dollar. The currency crisis caused people in the colony to stock up on food and consumer goods, with local shops gradually emptying. China announced that if the United Kingdom refused to conclude a bilateral agreement for the territory by the end of September 1984, it would create its reunification plan. The negotiations were prompted by a message from Margaret Thatcher to Chinese envoy Zhao Ziyang, in which Britain agreed to hand over the colony if the Chinese side maintained the status quo in Hong Kong. The result was immediate, and during a meeting in October 1983, the proposal was assessed as "constructive and reasonable" (Ngok, 1997).

By late 1983 and early 1984, however, the Chinese government announced that it did not want to adopt the "English scenario" as the basis of its future policy towards its former colony but planned to maintain the old system of relations. This was a major topic of discussion between Chinese leaders and Sir Geoffrey Howe, the Secretary of State for Foreign and Commonwealth Affairs during his visits to Beijing in the spring of 1984. To finalize the bilateral agreement on the Hong Kong issue, a permanent working group between the two countries started work in the Chinese capital. The parties approved the Chinese and English texts of the treaties which were published in Beijing, Hong Kong and London on 26 September 1984 (Ngok, 1997; Shenshina, 2006).

By this time, an office was established in Hong Kong whose main task was to collect information and monitor the views and reactions of Hong Kong society to the submitted project accordingly. The survey was conducted among members of the city, legislative, administrative, and district councils as well as by analyzing local newspapers and magazines. The results of the opinion monitoring were transmitted to the Governor by November 1984. It showed that the population lacked a clear view of the agreement. According to the survey, a significant proportion of the people said that they thought it was possible and reasonable for Hong Kong to develop under the terms of the bilateral documents. On December 5, 1984, the lower house of the British

Parliament approved the draft agreement, and on December 10 of that year, the upper house followed suit. On December 19, the Joint Declaration was signed between Margaret Thatcher and State Council Premier Zhao Ziyang about returning Hong Kong to Chinese jurisdiction. Based on this agreement, Hong Kong was returning to Chinese sovereignty by the first of July 1997. A Special Administrative Region (hereinafter referred to as SAR) was to be established in the former British territory in accordance with Article 31 of the PRC Constitution. It came under the control of the Beijing government, with rights in all spheres except foreign policy and defense (Shenshina, 2006).

The 1984 agreement stipulated that the returned territory was to have three branches of government – legislative, executive, and judicial. The appointment of the head of local government will be based on consultations and elections. China guarantees that, from 1 July 1997, the socio-economic system existing in Hong Kong will be maintained for 50 years. The economic system, the free port status, and the commercial and monetary center will also remain unchanged. Cultural ties will not be subject to any restrictions by China on the outside world. Thus, all previous agreements will not be rendered invalid. The inhabitants of the area will not be restricted in any way in their rights and freedoms. All foreign nationals, and officials will continue to hold their posts. However, foreigners will no longer be entitled to hold certain posts, such as department heads in the Hong Kong government from 1997. The finance system will also remain independent, bypassing the taxation system by the government in Beijing. In addition, the PRC was committed to maintaining Hong Kong's status in the Asia-Pacific region. Local cultural and educational officials will also not be subject to restrictions by the central government in Beijing (Official Publication, 1984).

The PRC also planned to continue to use Hong Kong as an intermediary to establish and maintain diplomatic relations with neighboring regions (such as South Korea). It also stipulated that neighboring Asian countries can apply for the establishment of non-governmental institutions on the territory of the former colony after 1997. The maintenance of security and order within Hong Kong was overseen by local authorities, but the central government also deployed additional forces within Hong Kong (Official Publication, 1984).

Under the agreement and the Basic Law, China gave the right to an ATS passport to Chinese people whose place of birth is Hong Kong or who have lived in the territory for at least seven years. People of other ethnic origins who have chosen the former British colony as their permanent place of residence and have lived there for at least seven years also had this right. A separate exchange of memoranda between the two heads of state took place on this point, where the issue of obtaining citizenship and a passport was identified as the most important issue.

Thus, the people of Hong Kong, which until 30 June 1997 enjoyed the right of "British Overseas Territories Citizens", have the right to get a British Overseas Territories (BOT) passport. In addition to a BOT passport, they were entitled to a British passport under the category of "British Overseas Citizens" (BOC). This right, however, did not enable them to stay (live) permanently in British territory but protected from consuls in relation with third countries. More than two million people received this kind of passport, which was more than half of Hong Kong's population. The other half claimed a special Hong Kong SAR ID card. In general, allowing the replacement of old passports with new ones, the British government wanted to prevent mass emigration from the former colony to British territory after 1997. In addition, the British government planned to ensure the local population the right to permanent residence in Hong Kong, as well as the right to consular service in other countries. China considered the use of British passports on its territories unacceptable. However, the Chinese officials indicated that there would be no objection on their part to the use of these English passports to travel abroad (Chan, 2006).

To consult further on the joint declaration cases, discuss the timely transfer of power, and exchange information, London and Beijing set up a liaison group. The purpose of the group was to consult on the negotiation of existing agreements and to facilitate the development and conclusion of new agreements in all areas that were consistent with Hong Kong's renegotiated status. From July 1988 until January 2000, it acquired a permanent establishment in Hong Kong (Chan, 2006).

The Advisory Group dealt with the participation of Hong Kong in international agreements as well as the further development of the colony. It was also decided to set up a special land commission during the colony's transition period to settle land leasing issues and avoid possible conflicts. The group was chaired by the deputy head of the State Council Chancellery, the English authorities were obliged to lease their land each year to industry, earning more than ten percent of the profit. Relying on the details of the bilateral agreement, the English administration still retained the right to lease land in Hong Kong, but with the mandatory condition that 5 percent of the rent would go to the future SAR government fund (Shenshina, 2006).

The agreement also noted that during the transition period the British administration would remain in the territory, which would be responsible for economic and social development and welfare. The parties thus reached a general compromise on the issue, and the PRC central government not only promised to cooperate with the British without interfering with the colony authorities but in practice allowed the United Kingdom to resolve the working issues of the transition period peacefully. The PRC went on

to declare a phase in the preparation of the Basic Law of the SAR, which would be the basis for the continued existence of a capitalist system in Hong Kong after 1997. By May 1985, the joint declaration was finally ratified, and the instruments of ratification were later exchanged in the Chinese capital (Chan, 2006; Shenshina, 2006).

Soon after the Joint Sino-British declaration was made, the drafting of a "Basic Law" or "Mini-constitution" of the future PRC Special Administrative Region began. During the "transition period" until 2047, different basic laws were to apply to the Chinese mainland and the territory and the Hong Kong SAR (in the first case the PRC Constitution, in the second – the HKSAR Basic Law), the legal status of citizens in both territories would also be different in terms of political rights and freedoms, as well as personal, social and economic rights and duties. And there will be greater political and ideological freedom for Hong Kong residents than for the rest of the PRC (Shenshina, 2006).

In 1985, the National People's Congress set up the Basic Law Development Committee (BLDC), laying the groundwork for the transfer of sovereignty in Hong Kong from the UK to China. The Committee was responsible for writing the draft Basic Law. In June 1985, the Standing Committee of the National People's Congress (NPCSC) approved the membership of the BLDC, which consisted of 59 members – 36 from the PRC and 23 from Hong Kong. Chaired by Chinese diplomat Ji Pengfei. Twelve of the 23 committee members from Hong Kong were related to the city's business and industrial sectors. Also in 1985, the Basic Law Consultative Committee (BLCC), made up of Hong Kong community leaders, was set up to gather the views of Hong Kong residents. Like the BLDC, the BLCC was dominated by members of the business and professional elite (Chai, 1991).

The first draft was published in April 1988, followed by five months of public consultation. The second draft was published in February 1989, and the subsequent consultation period ended in October 1989. The Basic Law was promulgated by the National People's Congress on 4 April 1990, together with the designs for the Regional Flag and the Regional Emblem of the Hong Kong SAR (Chai, 1991).

The process of creating the Basic Law coincided with the weakening of the role of the Communist Party in the Soviet Union and the policy of economic liberalization launched by Mikhail Gorbachev, the last General Secretary of the CPSU Central Committee, in the so-called "perestroika" (1985–1991). Which led to a significant weakening of the role of communist organizations in Europe, the end of the Cold War, then the collapse of the Soviet Union in 1991, and even before that, the fall of the Berlin Wall on 9 November 1989. In May 1989, Mikhail Gorbachev, who had by then become the embodiment of

"world democratic freedoms" , visited Beijing. This event coincided with the largest student protest movement in the history of China, with its demands for democratization, which went down in history as the "Tiananmen Square Events" of May–June 1989. (Shenshina, 2006).

On June 4, 1989, two BLDC members representing the fledgling democratic camp, Martin Li and Szeto Wah, announced that they would suspend their participation in the committee after the 1989 Tiananmen Square Protest was broken up by troops. In September 1989 Li announced that he would return to the BLDC after many of his supporters in Hong Kong called for it. However, in October 1989 Beijing expelled Li and Szeto from the BLDC as "subversive elements" . Li and Szeto expressed support for student activists in Beijing and later led the "Hong Kong Alliance for Patriotic Democratic Movements" in China, an organization helping political dissidents to leave China after the 4 June crackdown (So, 2000).

The main difference between the Basic Law and the Constitution of the People's Republic of China is that it enshrines the democratic principle of the separation of powers. This is that each of the branches of government (the legislature, the executive, and the judiciary) is independent and autonomous in the exercise of its powers; no branch of government can take over the functions of another branch of government. All state organs act within their competence. Because of this, since the publication of the Basic Law, its interpretation has served and continues to serve as a stumbling block between the "Right" and "Left" sections of Hong Kong and Chinese society. The main points of contention boil down to (Zhu, 2019):

- The problem of the Right of Residence. In 1999, the HKSAR government attempted to interpret Articles 22 and 24 of the Basic Law to avoid the potential influx of more than one million Mainlanders (according to government estimates) into Hong Kong. This has sparked a debate on judicial independence in Hong Kong.

- Article 23 of the Basic Law requires Hong Kong to make laws on its own to prohibit anti-government activities including treason, dissent, sedition, subversion of the Central People's Government, and theft of state secrets. This became a subject of considerable controversy when the HKSAR government attempted to introduce laws to implement the Article in 2002–2003. The proposed legislation gave a lot of power to the police, such as the ability to search the home of a "suspected terrorist"without a court order. This led to a public outcry and resulted in a major demonstration in 2003 called the "First of July March" when over five hundred thousand people took to the streets on 1 July 2003.

Following the demonstrations, the government was forced to shelve the unpopular law.

- The possibility of universal suffrage. Universal suffrage for the election of the Leader and for all seats of the Legislative Council is retained under Articles 45 and 68 of the Basic Law. However, the conservative camp and judicial experts in Mainland China argued that this principle would violate the ″Principle of Gradual and Organised Progress″ and ″in light of the actual situation,″it was decided to exclude the possibility of universal suffrage in 2004.

- The question is whether salary cuts for civil servants are permitted in the presence of a budget deficit. Under Article 100 of the Basic Law, civil servants would not lose pay and would enjoy all the same benefits as before 1997. However, Article 107 provides that the HKSAR government should follow the principle of keeping expenditure within revenue limits in its budget formulation. During the economic downturn after 1997, there were growing fiscal deficits (and in 2007/08 a record surplus). The government first cut officials' salaries during the recession and then increased them sharply during the recovery of the budget deficit.

- After Tung Chee-Hwa resigned on 12 March 2005, two years before his term expired in 2007. A dispute arose between the Standing Committee of the National People's Congress and the legal community as well as Hong Kong Democrats over the fate of the remaining ″two years″ , the National People's Congress decided that they would be added to the term of the next leader. Whereas many Hong Kong residents see the ″interpretation″ from the Standing Committee as an intrusion into the Hong Kong legal system by the Mainland government and a violation of the ″One Country, Two Systems″ principle, threatening the rule of law.

- Article 95 provides for mutual judicial assistance between Hong Kong and the PRC; however, serious stumbling blocks, such as the death penalty, stand in the way of a formal understanding of ″extradition″ . In addition, the HKSAR authorities have ruled that Articles 6 and 7 of the PRC Penal Code do not give Hong Kong sole jurisdiction in criminal cases, especially when the crime is committed outside the HKSAR's borders. The current status quo is that Hong Kong asks for the return of Hong Kong residents who have committed crimes in Hong Kong and are arrested in the PRC. However, PRC residents who

commit a crime in Hong Kong are extradited to mainland authorities. In cases of concurrent jurisdiction, however, the Central Government requires the trial to take place on the mainland. Local democrats such as Albert Chen, a teacher, and Gladys Lee, chairwoman of the Hong Kong justice district of the International Commission of Jurists, consider this situation has serious ramifications for judicial independence in Hong Kong and was also one of the reasons for the public protests of the 2013–2014 so-called "Umbrella Revolution".

5.4 Hong Kong and the PRC Economic Integration

After the founding of the PRC in 1949, and especially after the outbreak of the Korean War in 1950, China lost its main trade and economic partner – the United States. This loss was so significant that both Mao Zedong and Zhou Enlai repeatedly appealed to the American leadership to resume trade between the two countries. But the US authorities were adamant and not only did not trade with China themselves but also imposed an international ban embargo on trade with socialist countries (Chiu & Lui, 2009).

In this environment, the economic interaction between Hong Kong and mainland China has long been reduced with Hong Kong playing the role of a "keyhole" connecting China with the global economic system. All three parties benefited economically as a result: China, which was economically isolated, had a stable channel for foreign exchange. Hong Kong's business partners, who did not want to trade with China directly, made a profit without nominally violating the embargo imposed by the US; and Hong Kong itself, acting as an intermediary, firstly, at low prices, obtained the resources it needed from China, which allowed Hong Kong to keep domestic prices in check, and secondly, made foreign exchange profits based on a low trade surcharge on cheap Chinese imports, which, however, on the scale of international trade, brought significant profits to Hong Kong's economy (Tatlow, 2012).

Another factor influencing the fast economic growth of Hong Kong was the large-scale migration from mainland China during and after the Civil War (1946–1949). The Civil War and the "mass exodus"caused by the Communist Party's takeover of Shanghai in 1949 eventually led to the decisive rise of Hong Kong, whose population increased by nearly 800,000 people in 1949 alone, according to state records. Those time, Hong Kong experienced a significant influx of people from outside the province of Guangdong, many of whom were Chinese and foreign businessmen from Shanghai – the "Paris of China" of the 20s and 40s – who had fled Communist rule after being labeled "members of the counter-revolutionary bourgeoisie" and having their

homes and possessions confiscated. Together with their business acumen, the Shanghai tycoons and small factory owners lined up their capital to the south, and over the next decade, they gained a foothold in Hong Kong. Most of them invested in real estate, infrastructure, and industry, especially in the development of textile enterprises and the production of synthetic materials, many of their beginnings later subsequently developed into large successful businesses (Wong, 1988).

The above form of economic interaction continued unchanged until the early 1980s when the prospect of Hong Kong becoming under PRC sovereignty caused a massive outflow of capital from Hong Kong, but this instability was soon mitigated by the economic reforms in the PRC, after which foreign capital gradually returned to Hong Kong. China's economic reforms have benefited the Chinese economy, marking the beginning of a new round of economic development for the Asia Pacific in general and for the economies of Hong Kong and China in particular (Chiu & Lui, 2009).

Soon after the beginning of the economic reforms in the PRC, Hong Kong, and China experienced a massive inflow of foreign capital that brought their economies even closer together. It enabled Hong Kong to achieve a leap in economic development and compelled mainland China to address its internal economic problems, primarily corruption. Which was combated in a massive effort led by the CPC, which began by likening corruption to some ″dangerous illusion that constitutes a challenge to the successfully unfolding struggle of the Party for New China″ and consequently, for the new economic model of the People's Republic of China (Dodd, 2016).

That resulted in a massive relocation of Hong Kong industrial facilities to the PRC territory from the late 1970s to the late 1990s and a significant increase in the pace of growth of trade turnover between China and Hong Kong, which rose by about 30% a year during that period. At the same time, a quarter of all Hong Kong's imports came from mainland China. Hong Kong imported drinking water and food, fuel, and industrial raw materials from China. The PRC, on the other hand, imported electronics, new technologies, communications equipment, and vehicles from Hong Kong (Chiu & Lui, 2009).

A specific feature of the economic interaction between Hong Kong and the PRC at that time was the fact that all the enterprises established by Hong Kong in China were export-oriented, but the distribution of goods produced at those enterprises was done by Hong Kong itself, thus re-exporting its products and receiving double benefits in the form of trade surplus and those funds that were saved during cheap production in China (Hu & Chan, 2002).

The important area of China and Hong Kong's economic interaction used to be real estate. By 1984, Hong Kong's investments were already ″scat-

tered over many provincial cities″ , with investors mainly investing in construction, tourism development, trade, foodstuffs, textiles, and agricultural development. This pattern of investment continued in subsequent years. In the eighties, Hong Kong accounted for more than fifteen percent of China's exports. It was also actively involved in training personnel for future foreign trade. In general, after 1985, China occupied a central position concerning Hong Kong's foreign trade, second only to the United States in all respects. The overall trade situation in Hong Kong-China relations was positive, having a significant impact on the overall living situation of Hong Kong society (Chiu & Lui, 2009).

The official number of Chinese companies that were registered in Hong Kong in 1987 was more than 17,000. Mainly investment companies were opened that were involved in selling raw materials and industrial products as well as in agriculture. The areas in which the PRC was interested were quite diverse: tourism, transportation, construction, industry, cinema, publishing, etc. At the end of the eighties, the amount of Chinese investment equaled the level of US investment in Hong Kong territory. In the course of its existence, many companies produced parts, and various machinery that was in demand by Chinese industry. In the early nineties, every province and major city in China already had a foreign trade partner company in Hong Kong (Hu & Chan, 2002).

Despite the dominance of the Hong Kong economy over the Chinese economy during this period, expressed in Hong Kong's use of cheap Chinese labor and the territories of the PRC, which were subject to large-scale industrial pollution due to the relocation of Hong Kong enterprises there, these economic relations remained mutually beneficial, as China, in turn, became the owner of many industrial enterprises in its territory, which, firstly, promoted the development of Chinese industry itself and, secondly, contributed to the development of Chinese industry. For example, in 1997 approximately 5 million Chinese nationals were employed in enterprises based in Hong Kong in the south of the PRC (Hu & Chan, 2002; Chiu & Lui, 2009).

In the nineties, Hong Kong turned into an industrial center, which due to the small size of its local market had to export about 90% of the production. The quality and range of the goods produced in Hong Kong gradually increased. Household appliances and toys, parts for optical and electronic devices, watches, and jewelry prevailed in this period. Meanwhile, the Hong Kong economy depended on imported raw materials. Without food, water, and energy supplied from the PRC the city could not survive. However, in the process of industrialization, Hong Kong moved to the next level. Labor-intensive production was transferred to SEZs and other low-wage areas located on the other side of the border. For the city itself, the basis of the

economy used to be the service sector, which included trade, tourist services, real estate operations, finance, and insurance. After Tokyo, Hong Kong has long been considered the second most important financial center in Asia. At that time representative offices of more than 150 banks were located there (Hu & Chan, 2002; Chiu & Lui, 2009).

In the course of the aforementioned twenty-year period in the development of economic relations between Hong Kong and the Chinese mainland, the latter underwent a series of significant economic transformations and came a long way in its economic development, which made it unprofitable to use the economic interaction tools of the past and suggested new approaches by investors to the booming and increasingly complex Chinese market. Therefore, already in the early 2000s, there was a reorientation of Hong Kong investors from investing in the Chinese industry to re-export cheap Chinese goods to investing in different service industries. Hong Kong investors have been most active in the financial sector of the Chinese economy, banking, real estate, and tourism. The aforementioned reorientation of Hong Kong investors led to an even greater convergence of the two economies and a rapid jump in the development of the services sector within the Chinese economy (Li et al., 2011).

By the early 2000s, however, the PRC's economic rise and its transition to a market economy, which opened up foreign trade to China, had affected Hong Kong's role in the Chinese economy. The very function of a trade intermediary, which Hong Kong fulfilled throughout half of the last century, ceased to be the only important one, as China began to become an independent participant in international trade. Thus, the development of the Chinese economy slightly diminished the role of the Hong Kong economy for itself, but the economic interaction between China and Hong Kong did not stop. It had once again to change its form, which slightly decreased trade at the expense of increasing independent trade of the PRC with other countries, primarily with the United States and Japan. Thus, according to the Hong Kong Trade Development Center, in 2012. Hong Kong was the third trading partner of the PRC after the US and Japan. However, despite the decline in direct trade between the PRC and Hong Kong, their economic interaction has become more complex and intensified. First, Hong Kong continued to be China's main source of foreign investment. Second, by the early 2000s, China began to invest in Hong Kong's economy on its own. Thirdly, Hong Kong was gradually becoming a major offshore center for the Chinese capital (Sapir & Mavrodis, 2019).

All of the changes described above regarding the form of economic interaction between Hong Kong and Mainland China were reflected in the trade agreement CEPA (Mainland and Hong Kong Closer Economic Partnership

Arrangement) which was signed on 29 June 2003. The signing of the Closer Economic Partnership Agreements (CEPA) between Mainland China and Hong Kong and Macau in 2003 was of great importance for the future development of the bordering areas of the Guangdong Province (Yuan, 2003).

The purpose of the CEPA was to support and strengthen economic cooperation and integration between Hong Kong, Macau, and Mainland China. The CEPA rules on economic liberalization, aggregate market access, and other trade rules were broader than the commitments made by Mainland China upon accession to WTO (Yuan, 2003).

The CEPA regulates three areas of activity:

- Trade-in goods. All products manufactured in Hong Kong and Macao that meet the requirements of the CEPA are not subject to customs duties when imported into China;

- Provision of services. Hong Kong service providers are granted preferential treatment when entering the PRC market in various areas. Also, professional organizations in Hong Kong and Chinese regulatory authorities have signed several agreements on mutual recognition of professional classifications;

- Simplification of trade and investment regimes. Both sides agreed to strengthen cooperation in various areas of trade and investment and strive to improve the overall business environment.

The CEPA also provides privileges in the following areas:

- Large shareholding: Hong Kong service providers are entitled to a large shareholding (even up to 100% in some areas) in Chinese service providers;

- Lower threshold of capital: capital requirements for starting a business in China have been significantly lowered, making it possible for smaller businesses to enter the market;

- Recognition of Hong Kong qualifications (certificates, diplomas, degrees, etc.): eligible Hong Kong residents have the right to take professional and technical qualification exams in Mainland China in a wide range of specialties and to obtain current professional qualification certificates.

Under the terms of this treaty, which was designed to help liberalize Hong Kong-mainland trade relations for mutual benefit and greatly enhance the

existing economic relationship, the two sides agreed on three main points, such as "duty-free entry of Hong Kong-origin goods into Mainland China, unimpeded entry of Hong Kong service businesses into the Chinese market and improved interaction and investment background for both sides to improve the business environment as a whole" (Yuan, 2003; Wang, 2016).

Hong Kong plays a leading role in FDI inflows, accounting for over 70 percent of FDI from China. Most of the mainland's inward direct investment comes from Hong Kong. As well as most of the mainland's outward direct investment goes to Hong Kong. The graph below illustrates that Hong Kong's investment is part of mainland China's inbound direct investment and is interrelated with Hong Kong's direct investment in China.

De facto and de jure, Hong Kong is the main offshore area of the PRC and the main supplier and recipient of foreign investment, far ahead of all other foreign donors and recipients of Chinese investment.

The distribution of the structure of investment by countries/regions with a concentration in Hong Kong (as well as in Virgin Islands and Cayman Islands), is explained by circular schemes, in which a significant part of the investment flowing into China through Hong Kong is exported to obtain benefits provided to foreign investors by PRC's national capital. An important factor that puts Hong Kong in the leading position for the origin of FDI in the PRC is also the fact that companies in this SAR are used by enterprises resident in China for listing on the Hong Kong Stock Exchange. Hong Kong also acts as an intermediary for some investments from Taiwan to mainland China, due to Hong Kong's greater experience and advantages with the Chinese market. It is difficult to determine how much direct foreign investment comes from Hong Kong itself to the PRC, and how much comes through offshore and semi-offshore schemes from third countries. A similar situation is observed in the structure of China's foreign trade, where Hong Kong is the second importer of finished products after the U.S. (almost 14%), which is the result of its active re-export activities. Other Asian countries investing directly in China are targeting export-oriented industries due to the low cost of labor in the secondary sector. Thus, they seek to maintain their position in competitiveness by transferring labor-intensive industries to the PRC, which helps them achieve a reduction in the cost of finished goods. U.S. and European direct investors are guided to a greater extent by the vastness of China's domestic market, investing mainly in capital-intensive industries. The main goal for them is to secure their position in the Chinese market (Wang, 2016; KPMG, 2019).

During the last decade there has been a shift in investment from the secondary to the tertiary sector of the economy, i.e., the service sector. This happened because foreign investors began to consider the PRC market as a

final buyer's market. In turn, manufacturers are changing their production strategy, shifting from cheap export products to higher value-added, high-tech goods. According to KPMG, they accounted for about a quarter of all FDI invested in industrial production in 2016. In 2015, the tertiary sector – the services sector already accounted for $67 billion of FDI, or 70%. The secondary sector has experienced opposite changes: the massive share of FDI has declined year after year to only 19% (Wang, 2016; KPMG, 2019).

In 2007–2008, the PRC government adjusted its policy to attract foreign investment in the service sector. China's Law on Corporate Income Taxes introduced a 25% corporate income tax, replacing the previous higher tax rate of 33% for companies operating in certain segments of the service sector. One of the main ways for foreign enterprises to enter the PRC market is through mergers and acquisitions. Due to the continuous growth of the Chinese economy, M&A deals are an alternative to greenfield investment projects. The State Development and Reform Committee together with the Ministry of Commerce of the PRC, issued a regulation on "Mergers and Acquisitions between Companies Incorporated in China with Foreign Participation" (Wang, 2016; KPMG, 2019).

Among the main reasons for the rapid growth of the Chinese economy today, in addition to the inflow of foreign direct investment, is an active policy of expansion of Chinese capital in foreign markets. As one of the largest recipients of FDI, the Chinese government has been able to competently transform foreign capital into independent foreign investment. Like many countries around the world, China predominantly invests in countries with stable economies. By the same token, the PRC government chooses the industries to invest in that can bring as much benefit as possible and help increase prosperity. The government plays a significant role in investment – about 80% of all non-financial direct investment from China comes from companies owned by state capital. This phenomenon is associated with the effect of soft budget constraints, in which companies have no fear of insolvency, as they can always count on the support of the state. China's accession to the WTO in 2001 and the intensification of globalization significantly complicated the position of Chinese firms inside the country, where the positions of foreign MNCs with more resources than Chinese enterprises began to strengthen. This fact became an incentive for companies from China to take advantage of the economies of scale that can be achieved by entering foreign markets. When investing in other countries, China also considers the factors of production's costs. In terms of cheap labor, China is displaced by developing Asian countries such as Sri Lanka, Cambodia, Vietnam, etc. Another important factor pushing Chinese enterprises to invest abroad is the narrow domestic market (Wang, 2016; Asongu et al., 2018).

APAC countries account for the largest share of FDI due to their geographic and cultural proximity – 72% of total FDI accumulated. Of these, about 83% of Chinese investment in the APAC is concentrated in Hong Kong, which has been used as an offshore zone since the openness reform period. Latin America ranks second in attractiveness to Chinese investors, with the bulk of the region's capital (about 90%) concentrated offshore in the Cayman Islands and the Virgin Islands. Only 6% of FDI from China goes to Europe, with a small share of 1% to Russia. The U.S. also has Chinese capital – 2%. Africa accounts for 4% of Chinese FDI due to cheap labor and rich, untapped natural resources (Asongu et al., 2018).

Both China and Hong Kong's economies have come a long way, which, however, up to the present day is developing according to the scheme adopted in 1949, in which Hong Kong acts as an international intermediary in foreign economic and trade relations of Mainland China. This form of cooperation between China and Hong Kong is still mutually beneficial, and both sides have taken active steps to maintain and improve it. The CEPA treaty, which reflects China's paternalistic economic policy on Hong Kong, is the result of the strategic interest Hong Kong has for the economy of Mainland China and its further development and also for maintaining the current political regime, under which China, given the obvious ″influence of globalization on all areas of the development of the world community″ is trying to ″balance the interests of Hong Kong with the interests of mainland China″ (Cheung, 2015).

On the one hand, China is attempting to achieve a balance between its rapid economic growth and the gradualness of its political transition, and on the other hand, it is responding to the challenges of global democratization which is bringing about widespread integration processes in the world economy in which China must participate to preserve itself. Hong Kong, on the other hand, is a tool used by China to integrate the PRC into the world economic system and to strengthen the influence of Chinese capital and the RMB in the world financial markets to further promote the RMB as the world's senior currency. The future development of economic interaction between Hong Kong and Mainland China will proceed within the already established paradigm, with the PRC's role strengthening and the Hong Kong economy gradually absorbing the economy of Mainland China in order to strengthen its own economic significance both in the Asia in particular and in the global economy as a whole (Cable, 2017).

6 Shenzhen – ″Reform and Opening-up″ – Demonstration City

From its inception to the present, Shenzhen has been a place of economic, social, political, urban, architectural, and infrastructural experimentation. In 2019, the 40th anniversary of the ″Reform and Opening-up″ policy, Shenzhen was declared a ″demonstration city of advanced socialism with Chinese characteristics″ . The city grew up in the open field, adapting and transforming the social structure and organization, architecture and urbanization, and thus made it the first and unique of its kind in many ways (Du, 2020).

Thus, in 1980, Shenzhen became the first city to break through the traditional permanent employment system and smashed the ″iron rice bowl″ (铁饭碗 tiefanwan). Shenzhen implemented two-way selection and established a labor contract system and an auxiliary system. In 1982, launched a pilot wage reform, improved the labor distribution system, and led the implementation of mainland China's wage system, giving enterprises autonomy in resource allocation so that workers could earn a higher salary (Ip, 1995).

Shenzhen was also the first place to conduct a price reform experiment. In 1984, the city opened the supply of grain, meat, cotton cloth, edible oil, and other goods, and liberalized prices, ending the coupon system that had existed for almost 40 years in the PRC, 10 years earlier than the rest of the country. By the end of 1987, the proportion of goods with liberalized prices in Shenzhen reached 91.5%, successfully breaking the barrier of price reform and becoming a model in breaking the stagnant system of planned price management (Wong, 1987).

In 1982, the Chinese government officially approved the Dayawan Nuclear Power Plant project, which became mainland China's first commercial nuclear power plant with a capacity of several million KW. This plant contributed to China's breakthrough in nuclear power development. The pattern of Chinese nuclear energy through ″introduction, assimilation, absorption, and innovation″ came out of Dayawan to China (Chan, 1995).

On July 8, 1983, the Shenzhen Baoan County United Investment Co issued the first share in new China, so the first joint-stock company was born. On June 26, 1991, the shares of Baoan United Investment began to be listed on the Shenzhen Stock Exchange, and since then the Chinese joint-stock companies developed rapidly. China's first overseas-funded bank, Nanyang Commercial Bank Shenzhen Branch, opened in 1982, and the first joint-stock commercial bank on the Chinese mainland, China Merchants Bank, was established in Shenzhen in 1987. China's first joint stock insurance company was established in Shekou in 1988. The company has expanded

rapidly to become China Ping An Group (Zhu, 1994).

Figure 7: The International Trade Organization building, Shenzhen. 1983

Source: Shenzhen city archive.

In May 1988, The State Foreign Exchange Administration approved the establishment of the Shenzhen Foreign Exchange Trading Center, putting an end to the ban on the trading of foreign exchanges under the planned economy. And in 1990, China's first stock exchange, Shenzhen Stock Exchange, was established. The stock market has helped companies raise funds and some of them grow into giants from small players, such as China Vanke and Shenzhen Development Bank, now known as Ping An Bank. In December

1987, the first public auction of land use rights took place in Shenzhen. For the first time in China, land use rights entered the market as an asset. This auction has been called the ″first revolution″ since the construction of the land-use system in the PRC (Zhu, 1994).

In 1984 was completed China's tallest skyscraper, the 50-story International Trade Center, and Shenzhen began to emerge as a ″skyscraper city″ . In 1985, the construction of Huaqiao theme park began, thus starting the creation of ″The window of the world″ theme park in Shenzhen. OCT Group is one of three largest theme parks corporations in the world and the top one in Asia (UnHabitat, 2019).

In 2008, Shenzhen was named the first city in China to pilot a national innovation city. Since then, independent innovation has become Shenzhen's hallmark. Shenzhen is transforming itself into China's Silicon Valley, developing the R&D sector in the Nanshan Technopark area and the investment sector in the Qianhai Pilot Service Zone. At the same time, the city is engaged in a major campaign to turn it into the green city of the future, the city of 1,000 parks, the capital of robotics and electric transport, and an international infrastructure hub on the border with Hong Kong. The city of the ″Chinese Dream″ , was announced by Xi Jinping in 2012 (Du, 2020),

Shenzhen is undoubtedly the locomotive of the entire Greater Bay Area and demonstrates to the world that it is possible to design and to build megacities of the future within a generation, in a matter of decades. Shenzhen is a ″special zone″ city, built as an experiment to introduce new economic, social, urban planning and environmental ideas that have shown outstanding results. Now it is the main city of Guangdong province and the entire region. It has surpassed all other cities in China in economic growth's rate, and its economic volume is second only to Shanghai and Beijing.

Shenzhen is a post-industrial city built on the principles of the knowledge economy and developing according to the rules of smart, green cities. The Shenzhen Bureau of Statistics declares that the production capacity of the Shenzhen SEZ increased from 270 million yuan in 1980, to 26,92 billion yuan in 2019. With an average growth rate of over 20 percent per year. Shenzhen's per capita GDP rose from 835 yuan in 1980 to 203.5 thousand yuan in 2019. The average annual growth rate was 9.8 percent. Looking at Shenzhen from the perspective of economic sectors, the third (service) and fourth (innovation) sectors account for almost 60 percent of economic capacity in 2019.

6.1 Shenzhen Master Plans 1982–2020

Shenzhen was originally planned as an experimental cluster, a free trade zone, where innovative industries would develop and where qualified personnel would flock. Accordingly, both industrial and urban development of the future city was regulated by the state plans.

The ″SEZ Shenzhen 1982–1986 Master Plan″ was the first version of master plans in Shenzhen. This plan envisioned a multi-center cluster – belted urban structure consisting of the Nantou Cluster, the Luohu Shanbu Cluster, and the Shatoujiao Cluster. These three clusters were to be connected by a major thoroughfare – Shennan Road from west to east. Following in this plan, the structure of the city began to develop in the direction of a polycentric scheme, which was the germ of its current structure (Bruton et al, 2005; Huang & Xie, 2012; Lei et al., 2020) .

The second plan, drawn up for 1986–1996, replaced the ″1982 SEZ Master Plan″ . In this plan, the urban structure was further strengthened and reinforced, while at the same time this plan fulfilled the function of promoting the sustainability of industrial development. Compared to the 1982 Master plan, the 1986 Master Plan had a more strategic view of urban land use and municipal infrastructure to ensure the comprehensive development of the SEZ. The plan at the time was for 0.8 million permanent residents and 0.3 million floating population. The plan identified five development clusters in the form of a belt: Nantou, Huaqiaocheng, Futian, Luohu, and Shatoujiao. The Nantou cluster aimed to develop the commercial and industrial sector; the Huaqiaocheng cluster contained an integrated land use from industry, tourism, real estate, and trade; the Futian cluster was to become the business center of the city by assuming administrative and commercial functions; the oldest Luohu district maintained its function as a transportation hub and commercial center; and the Shatoujiao cluster was to be developed into a major industrial area (Huang & Xie, 2012; Lei et al., 2020).

The clusters were designed to share natural landscapes such as rivers, forests or open spaces, providing green corridors in the urban space to improve the quality of life and the environment. To promote industrial development, this plan allocated fifteen industrial zones of different sizes designed for the development of electronics, light industry, building materials, engineering and textile industry. At the same time, the plan also provided sufficient land for residential construction, including 179 residential areas with a total area of 3,042 hectares with varying building densities and population densities (Huang & Xie, 2012; Lei et al., 2020).

To create a beautiful urban environment, the plan allocated space for 22 municipal or district-level public parks, five lychee gardens, as well as a 140-

kilometer green belt along the Yongqing Highway, and 10 tourist facilities that were to provide a framework for further transforming the city into a modern garden city.

The next milestone in Shenzhen's urban development was the Shenzhen Master Plan 1996–2010. According to this plan, the city's development should take place in an orderly fashion along the western central, and eastern axes to form a ″hierarchical urban network″ and a ″linear-cluster city″ (Huang & Xie, 2012; Lei et al., 2020).

Nine development clusters and six independent districts form Shenzhen's urban framework. Nine clusters will be distributed along the three proposed axes. Another important factor in this plan was the restoration of land transfer rights and the prevention of illegal and accidental transfers. According to this plan, the spatial layout of the city is organized into two systems: the urban planning space forms a ″W″ shape, and the conservation space forms an ″M″ shape. Urban planners consider that the interrelation of these two systems is ideal to promote the economic development of the city, especially for the development of high-tech industries, which require a pleasant urban environment, as well as allow to make the natural landscape easily accessible to citizens. All three axes of development are located in a north-south direction and extend outward from the core of the city (Huang & Xie, 2012).

The spatial layout was created on a large scale. Laying the foundation for the future Greater Bay Area Project (2017). Western industrial cluster and the Central Bao'an cluster, connecting eventually with the Guangzhou cluster. The eastern areas stretched toward Huizhou and Shantou and included the Eastern Industrial Cluster. The central clusters of Luohu and Lungang eventually connected the city with Hong Kong. The six independent districts – Gongming, Guangming, Shiyang, Kuiyong, and Dapeng and Nan'ao were located in ecologically significant areas that require special attention to regulate development and ensure environmental protection (Lei et al., 2020).

Most of the districts of modern Shenzhen were built after 2000, which significantly changed its urban structure. Also after 2000, the restoration of historical monuments and the renovation of old districts of the city began. Luohu district focused more on renovation, and innovative construction projects were mainly concentrated in Futian, Nanshan, and Yantian districts. By the mid 00s, infrastructure construction in Futian was generally completed, and the area of Futian Center had increased to 6 square kilometers. Already in 1999, the operating area of office buildings in Futian exceeded that of Luohu. By the end of 2004, more than 70 percent of corporate headquarters in Shenzhen had moved to the Futian Business Center. The construction of a modern HSR station linking Futian with Guangzhou South Station and Kowloon West Station (Hong Kong) added to the metropolitan significance

of the area (Huang & Xie, 2012; Lei et al., 2020).

At this stage, there was also a further expansion of the construction zone of the territory outside the SEZ. The city's modern infrastructure inside and outside the SEZ was being built. At that time, the coastal area in Bao'an district was also identified as a key area for the future commercial and innovation center of the city. The new Bao'an Center was to be built on reclaimed land by Shenzhen's new Master Plan 2007–2020.

The latest plan provided for the construction of the Qianhai city district, which, along with the Futian-Luohu districts, make up the polycentric structure of the city. The strategically important Bao'an area bordering Hong Kong and rapidly growing Guangzhou had a shortage of available land, so it was expanded mainly through land reclamation. In July 2010, the original boundary of the SEZ was officially removed, and consequently, the single policy extended to the entire territory of Shenzhen. As a result, land outside the boundaries of the SEZ began to have greater development potential. During this period, first, the active development of the Central Pearl River Delta where the Bao'an district is going to meet Guangzhou Qianhai district, Eastern Delta of the Pearl River – coastal and urban areas on the outskirts of Guangzhou and Huizhou, and then the western Delta – Jiangmen, Zhongshan, and Zhuhai began (Lei et al., 2020; Ding et al., 2022).

To protect the city's environment, Shenzhen authorities have also developed a plan to establish environmental control, and the city's expansion is also controlled by the Guangdong Provincial Government. The cluster centers outside the boundaries of the SEZ and the first two development phases of the city have gained importance for the development of Shenzhen and the Greater Bay Area Project. During the 2010s, the infrastructure provision of these areas was improved, and vacant areas began to be integrated with existing neighborhoods.

Speed and certain flexibility are the main features of all Shenzhen development plans. Looking at the history of Shenzhen over the past four decades, the rapid growth from a small border town to a megalopolis is an obvious phenomenon. And at the same time, Shenzhen's development is unpredictable. Although the predictions and plans are very bold, reality faces the challenges of uncertainty. Under such circumstances, the flexible development model provides great support for Shenzhen's continued success.

6.2 The Kowloon–Canton Railway, Luohu Crossing, and the Origins of Shenzhen

Many cities start with the construction of infrastructure. In Shenzhen's case, it was the ″Kowloon–Canton Railway″ (KCR). Before the New Territories of Hong Kong were leased to Britain in 1898, the designer of the Indian railway (Macdonald Stephensen) in 1864 proposed the plan of a railway line from Canton to Calcutta via Hong Kong (Guo & Zheng, 2018).

By the end of the 19th century, it was clear that the development of infrastructure determines the progress and prosperity of the economy, The British in Guangzhou (Canton), the Americans on the Beijing–Guangzhou section via Wuhan, the Russians together with the Belgians on the north, and the French on the Shanghai coast built railways during the Qing dynasty.In 1899, Hong Kong-based conglomerate Jardine Matheson partnered with the Hongkong and Shanghai Bank to create the British and Chinese Corporation, which won the right to build a railway from Kowloon to Guangzhou (Dewolf, 2018).

In 1908, then-governor Frederick Lugard justified the urgency by describing the railway as ″a question of preserving the predominance of Hong Kong, because it was an intermediary between the river ports of the Pearl River and the rest of the world. The railway finally opened on October 1, 1910 – but without a proper terminus. It took another six years to reclaim land and build Kowloon Station on the Tsim Sha Tsui waterfront. Service was slow at first, with only a few trains per day, and it was sometimes suspended due to political upheaval, economic malaise, and general lawlessness in China. By the 1920s, only half the passengers on the railway were headed to the mainland, with the rest taking the train to stations in Hong Kong (Guo & Zheng, 2018).

The railway from Kowloon to Guangzhou via Shenzhen, through the Luohu district on the Shenzhen river in Bao'an County, was the first reason for its rapid urbanization. During 1931–1936 several casinos were built and operated on Luohu, attracting visitors from both Hong Kong and Guangzhou. During the Japanese occupation of Hong Kong from 1941 to 1945, most residents fled Hong Kong by rail, although the railway was disrupted under Japanese rule due to a shortage of coal supply. And in 1945, when the British returned to Hong Kong, the population began to return rapidly, with up to 100,000 people a month coming to Hong Kong (Dewolf, 2018).

The next influx of refugees traveling from mainland China to Hong Kong via KCR happened when the Communists came to power in China. After that, in 1950, it was decided to stop the direct connection with Hong Kong and to make an official border, a pedestrian crossing, and a customs office

in Luohu. The railway linking Guangzhou and Kowloon ceased its original route for the next 30 years until the start of the "Reform and Opening-up" policy (Tan et al., 2018).

Around the same time, customs, and military stations were built on both sides of the pedestrian crossing and the Shenzhen River.

The crossing between Shenzhen and Hong Kong was indeed a keyhole through which contact was made between the two blocks of the "Cold War" . Meanwhile, the KCR continued to operate. There were 32 trains per day. During 1980–1982, KCR was modernized, the number of trains doubled, the line was electrified, and the stations along its route were rebuilt. In 1982, train dispatch frequency was increased from one every half hour to one every five minutes. And in ten years from 1982 to 1992 the number of passengers increased tenfold from 50,000 to half a million a day (Dewolf, 2018).

Figure 8: Passengers walking across the railway bridge to Shenzhen. 1980

Source: Shenzhen city archive, in Dewolf (2018).

At the same time, the land port of Luohu was developing into the world's largest and busiest border crossing serving about 250.000 transborder trips on a normal weekday (Tan et al., 2018).

Around the land port of Luohu has grown an area serving international,

predominantly Hong Kong investors and tourists. Hotels, spas, bus terminals. As early as 1984 the first skyscraper of an international financial center was built one kilometer from Luohu crossing. While the Chinese side of Luohu Passage was intensively developed to become the first urban center of a young metropolis, the Hong Kong side remains almost untouched by green fields. It was a kind of "buffer" zone designed as protection against migrants and the danger of attack during the Cold War (Tan et al., 2018).

The pedestrian port of Luohu generated a huge informal market with autonomous regulation in the border region. Shenzhen's municipal government could not act unilaterally and intervene because the site was contested by many social and institutional organizations (Tan et al., 2018).

Now a modern high-speed road has already been built from Kowloon to Guangzhou via Futian, and the Luohu crossing is only one of eight pedestrian crossings to Hong Kong from Shenzhen. But it has not lost its importance as the origin of the city on the Kowloon–Canton railway line.

6.3 From a "Bamboo Hut Village" to a Metropolis

In the mid-twentieth century, there were several settlements in what is now Shenzhen SEZ, most of which were fishing villages. The Pearl River Delta region had about twenty counties in addition to the major cities of Guangzhou and Huizhou. The population of these counties was engaged in handicrafts and industries, in the production of salt, cement, and trade with Hong Kong. During the Second World War, the Red Cross and the British Allied forces stationed in Huizhou and around the town took place, the legendary "Battle of Hong Kong" . In the mid-1950s the settlements of what is now Dongguan and Shenzhen were part of the Huiyang County of Huizhou. In the 70s the population of the fishing village of Yuming on the Shenzhen river, the border between Hong Kong and Shenzhen, was about five thousand people, and about 30 thousand more lived around the Luohu KCR station in Bao'an county (UnHabitat, 2019).

In 1979, the Chinese authorities led by Deng Xiaoping decided to establish special economic zones in the areas bordering Hong Kong and Macao. On January 23, 1979, China Merchants, the largest state-owned company at the time, established an industrial zone in Shekou (Nanshan) to attract Hong Kong investors and on March 5, 1979, Bao'an County was renamed Shenzhen – after the river separating Hong Kong from the rest of China. On 26 August 1980, the Standing Committee of the National People's Congress approved the Regulations of the Guangdong Province Special Economic Zone, and it is from this date that the Chinese government traces the history of Shenzhen (Yeung et al., 2009).

In 1981, the Ministry of Justice of the PRC, based on laws, orders, and policies, using the relevant legal codes of some foreign special export zones and free trade zones as an example, drafted and published the following four special legislative acts concerning SEZs.(Fang, 1994):

- "Temporary Regulations on SEZs in Guangdong Province to Control the Entry and Exit of Personnel into and Out of China" ;
- "Temporary Regulations on Enterprise Registration and Management in Guangdong Province SEZ" ;
- "Temporary Regulations on Wages in Guangdong Province SEZ" ;
- "Temporary Regulations on Land Management in Shenzhen SEZ" .

According to the Central Committee and Guangdong Provincial Party Committee, the development of Shenzhen SEZ was primarily planned.

As early as 1979 the construction of the Nanshan industrial estate was started, and in 1980 the construction of urban infrastructure, the Luohu urban district, and the seaports of Shekou and Chiwan began on a large scale. At the same time, Shenzhen University and the city library were opened. The next four years saw reforms in many areas – changes in the labor insurance system, wage system, and capital construction structure (UnHabitat, 2019).

Together with the construction of ports, China opened up its financial sector to foreign banks and investors. These transformations broke up the established planned economic system. SEZs not only opened China to the outside world, but also had a significant demonstration effect on reshaping the economic system throughout the country. In 1984, Deng Xiaoping visited the Shenzhen SEZ for the first time, declaring that the development of the Shenzhen SEZ demonstrated that China's SEZ policy was the right one (Fang, 1994).

With the participation of foreign technology, enterprises that carried out toll processing activities, i.e. assembly of products according to customer's samples, started to develop actively. Foreign capital was injected into three kinds of companies: Sino-foreign joint venture, joint business, and solely foreign enterprise. This made up for the lack of qualified personnel, necessary skills, and missing funds. (Ip, 1995).

Shenzhen addressed a wide range of issues, not only affecting foreign trade relations but also helping to develop the city's domestic infrastructure, which was a significant advantage in the context of attracting both foreign investors and work migrants to the region from China's hinterland.

Shenzhen was the first SEZ in the PRC to use market-based elements of the economic system. The skyscrapers, bustling traffic in the streets of Hong

Kong contrasted with the poor villages of Shenzhen 40 years ago. The Chinese government and the Guangdong provincial government were to transform the "countryside" into a modern, innovative city (Du, 2020).

Ezra Vogel notes that people are more interested in economic change than in political change. However, sometimes economic change is not possible if it is constrained by political conditions (Vogel, 1985). Thus, the challenge for the Chinese government at the time the creation of SEZs was to avoid systemic problems; accordingly, fundamental reforms were needed in every sphere of people's lives, including the political sphere. To ensure that China's economic system continued to function fully with market elements, it was necessary to test the viability of such a system in the experimental zones that the SEZs had become (Vogel, 1985).

Rural, underdeveloped regions were chosen to experiment with an open, market-based economy. For example, the village of Yuming on the Hong Kong border, where people lived in huts made of bamboo and straw in the 1950s and hunger was a common occurrence in the 1960s and 1970s (See Figure 9) (Liu et al., 2017).

Figure 9: Yumin village, 19730

Source: Shenzhen city archive.

According to the testimonies of the villagers, once they were permitted to engage in business activities in 1979, many feared reprisals for their possible enrichment, plus "capitalist, bourgeois elements" had only recently been criticized and persecuted by the "Hongwei Boys" during the "Cultural Revolution". Most people living in the village, however, had little to lose and were enthusiastic about the opportunity to become entrepreneurs. In 1979, given the green light and subsidies from the government, they began building a shipyard to produce fishing boats and equipment, procured fertilizers, and

started actively growing, processing, and selling agricultural products. In 1981, the collective income of the villagers became 600,000 RMB. (Liu et al., 2017).

In 1992, the government of Yuming Village set up the Fishermen's Fung Industrial Co Ltd, which became the first village-run joint-stock company in China. And in 2001, during the demolition and redevelopment of the old village, the villagers' residential land was finally turned into commercial land. This also achieved a breakthrough in the land issue and influenced the further development of the Village. In 2004, Fishermen's Village completed the transformation of the village into an integrated building and 11 residential buildings, equipped with various cultural, leisure, and recreational facilities, and set up the Fishermen's Village Property Management Co Ltd, which leases, operates, and manages the village buildings in a unified manner.(Liu et al., 2017).

6.4 Internal Migration, Hukou Registration and Urban Villages

In the 1980s, Shenzhen attracted hundreds of thousands of young people who went to the city in search of higher wages. Shenzhen was a destination for migrant workers, skilled technical and administrative personnel, mainly from the north and center of China. Since acquiring SEZ status and up to the present day, Shenzhen has seen very rapid population growth. from 3 to 10 million in a single decade. The exceptionally rapid growth in the number of permanent (that is, more than a year) residents in Shenzhen was reflected in the statistics: in 1980, Shenzhen had just over 300,000 residents, which rose to 1.2 million in 1988, 4.1 million in 1994, 7 million in 2000, and 10.5 million in 2011. Between 1979 and 2011, Shenzhen's permanent population grew about 333 times, with an average annual growth rate of more than eleven percent (Young, 2013).

Shenzhen in the 80s of the 20th century was an attractive place for ambitious young people. Popular folklore, the media, and cinema of those days portrayed young Chinese businessmen doing business in Shenzhen with foreign partners and realizing the Chinese and the ″American″ dream. Indeed, the history of all modern large Chinese corporations based in Hong Kong or Shenzhen goes back to the early to mid-80s (Du, 2020).

China developed a system of residence registration, or ″land-bound birth″ , known as the ″Hukou″ (户口 Hukou, literally ″yard's inhabitants″). In fact, because of this ″Hukou″ system, China maintains a radical separation of the rural population from the urban population. This system – lifelong urban or

rural residency - was introduced in modern China in 1958. It coincided with the collectivization of rural land (Young, 2013).

After the start of the reform and opening-up policy, China's rapid industrialization and urbanization needed to reform the Hukou system to adjust to the country's new economic reality. In 1984, the State Council conditionally opened the doors of cities in SEZs to peasants. At that time, villagers were allowed to obtain a new type of registration called "self-sufficient food grains" or partial Hukou, provided they fulfilled many of the requirements. The main requirements were that the migrant must be employed in the enterprise, have their own home in the new location and be able to provide their food grains. Holders of such partial hukou were still ineligible for many public services and could not move to other urban areas rated higher than their area of registration (Li, 1996).

In 1992, the PRC launched another form of residence registration called the "blue seal" – Hukou. Unlike the "self-sufficiency in food grains" reserved for rural residents, the "blue seal" Hukou was open to a wider range of people and allowed to migrate from smaller cities to larger towns and, in particular, to SEZs. However, to obtain the blue seal, one had to work in a joint venture or be a family member of investors (Li, 1996).

After China gained access to the World Trade Organization (WTO) in 2001, the Hukou system was further weakened. Although WTO membership exposed China's agricultural sector to foreign competition, resulting in job losses, it boosted labor-intensive sectors, especially in the textile and garment industry, resulting in increased demand for urban labor. Many firms and corporations secured hukou for their skilled employees (Young, 2013).

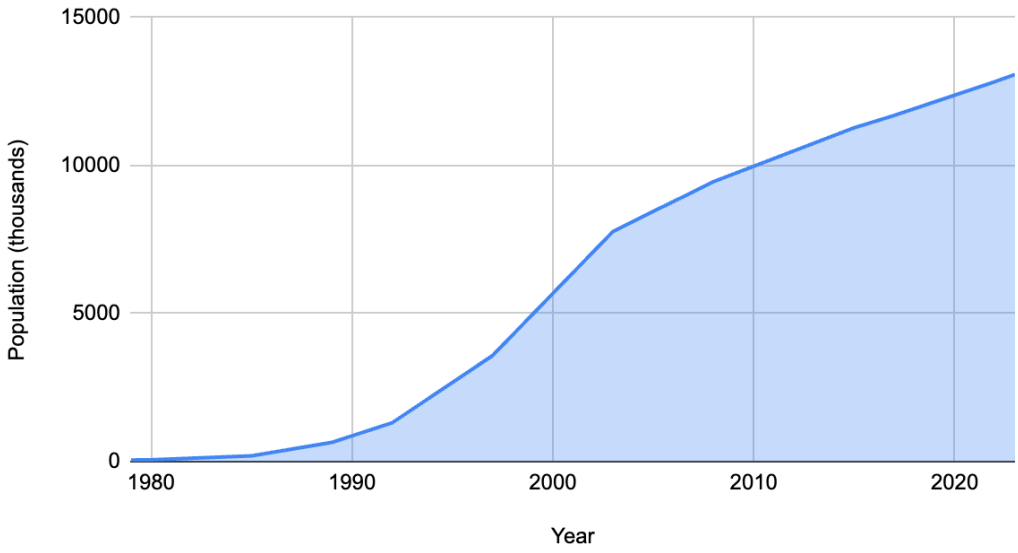
Despite the reforms, the current Hukou system remains, although is highly controversial. Some researchers argue that urban "Hukou" in many ways resembles the "Green Card" system in the United States. The Hukou in Chinese metropolitan cities entitle the holder to social security, free education and health care, as well as grants and subsidies from the city government, such as for the purchase of housing (Young, 2013).

In the case of the "Shenzhen Hukou" , it also entitled to travel freely to Hong Kong an unlimited number of times, spending no more than a week each time. To obtain a permanent residence permit or "Hukou" was established a point-based system for evaluating applicants. In Shenzhen, a unified point system has been in place since 2012 for evaluating rural migrants and recruiting workers. The main criteria for calculating "points" are the applicant's characteristics – education, technical skills, work experience, age and their tax payments. Additional factors are participation in social security schemes, housing conditions, bonuses, and other incentives at work. Increased points are provided for the categories of applicants required by the

city – technical and IT specialists, investors, teachers, and medical staff (Wu, 2018).

In 2010, out of the 11 million permanent residents, i.e. living in the city for more than a year, Shenzhen's population, only 2.5 million possessed an urban "Hukou". Consequently, migrant workers made up 75 percent of the city's population. The children of these migrants are not entitled to study in Shenzhen and very often remain in the care of grandparents in their place of residence, where they attend school. According to some studies, the total number of internal migrants without urban "Hukou" in China in 2010 was around 200 million people, and there were 130 million children who studied and lived apart from their parents at the place of their original "Hukou" (See Figure 10)(Young, 2013).

Figure 10: Shenzhen Population, 1979–2020



Source: Author based on UN, World population prospects (2023).

Nowadays only 20 percent of rural dwellers are eager to change their residence status. They have some rights that urban citizens do not have. For example, they can sublease or dispose of their land as they wish, conduct business on it, etc. (Burney & Pils, 2020).

Nevertheless, the issue of "Hukou" is directly related to wealth. There is still a significant differentiation between "urban" and "rural" residents due to differences in living standards, wages, and access to social services. The countryside continuously supplies the city with the labor force it needs

for low-skilled jobs. These workers are the most vulnerable segments of the population, often separated from their children, do not have access to social services, and have to work into old age (Burney & Pils, 2020).

Another phenomenon of rapid urbanization in the Pearl River Delta region is "villages in the city "(城里村 chenglicun). Some researchers compare this phenomenon with Brazilian "favelas" . However, the two terms have significant differences. Whereas "favelas" or "false urbanizations" were often created by squatting on land as satellites of large cities attracting cheap labor in search of affordable housing. The process of the formation of Chinese villages in the city in the area under consideration is fundamentally different (Al et al., 2014).

A new policy began with the introduction of land rents and business activities on land for villagers. An important source of income for land users came from selling their land to build all sorts of municipal and urban buildings on it. Besides land, there were still peasants' houses, at times being historic buildings, from which the villagers were not in a hurry to get rid. They also did not always get enough money to relocate, because at the very beginning of the reforms land was bought for prices much lower than its present value. As a result, the villagers, surrounded by growing cities, tended to choose one of the profit-making options available to them (Al et al., 2014).

In the 80s and 90s of the 20th century, they rebuilt their "Siheyuan" (四合院) into five or six-story concrete boxes, often located at arm's length from each other, with flats, rooms, and beds rented to migrant laborers arriving. The incessant influx of newcomers generated a strong demand for such housing. In the early stages of Shenzhen's construction, "Villages in the city" were the hub of its entire socio-cultural life. However, the inhabitants of such villages, despite their territorial location often in downtown, were formally villagers with no urban "Hukou" (Al et al., 2014).

The formation of a dual urbanization "village – city" is a feature of many modern cities in the PRC, the Pearl River Delta, and Shenzhen specifically. Urban villages have their own administration, police, village council or residents' cooperative, school, clinic or "health station" . Most villagers are migrant workers, sometimes students who come for short periods. Despite the symbiosis that exists between such villages and their surrounding cities, city administrations usually seek to resettle them to improve the "look of the city" or to create in their place condominiums and other infrastructure needed by the city. Because overcrowding, unsanitary conditions, and the presence of artisanal industries such as incineration, not only do not fit into the urban construction new paradigm, but they often threaten the urban ecological environment (He, 2015).

One example of a "village within a city" is Nantou – the urban village in the heart of Nanshan. The center of Bao'an County, renamed Shenzhen in 1979, was the small ancient fortress of Nantou. The history of Nantou goes back to the 3rd century AD, while the fortress walls around it were erected in 1394 during the Ming Dynasty. And yet, until 2016, this ancient site was almost forgotten and consigned to certain oblivion, being just one of the urban villages in Shenzhen City (See Figure 11) (Kaiser, 2019).

Figure 11: Nantou Ancient walls, Shenzhen

Source: Photo by Alexander Shafir, 2021.

The "Big construction" started in 1980 and Shenzhen began receiving a huge flood of migrants, and the fortress was rebuilt into income-creating housing – the historically important yellow sand fortress walls were partially deconstructed and concrete apartment blocks were erected to replace the originally listed landmarks. As many as nine hundred constructions were later deemed illegal buildings. Characteristically, most of the buildings in Nantou that were later declared illegal were erected from 1980–1984, during the birth of Shenzhen and the related huge flow of internal migrants. Beginning in 1983, the Shenzhen administration started to save the remains of the fortress wall and important historical monuments in the territory of Nantou, this process of "conservation" of the monument nevertheless lasted for decades until 2018, when Nantou was recognized by the city municipality as one of the ten major historical monuments in the territory of Shenzhen.

It has now been transformed into an art district of the city's urban history (Kaiser, 2019).

6.5 Stone Fever

The construction of the real estate, infrastructure facilities, and residential districts has been going on in Shenzhen at a record pace. At present a third of all buildings in the world are built in China, seven of the tallest buildings in the world can be found in China, as well as most of the giant infrastructure structures, such as ocean bridges, are also located in China (Du, 2020).

In 1980, the first commercial residential complex was built in Shenzhen. At that time, the Shenzhen government handed over the right to use the land, and Hong Kong businessmen provided the funding to build the buildings. Shenzhen also pioneered the use of land as a means of production under market conditions (Lopez, 2007).

China has become a world leader in the export of services for the construction and design of infrastructure and residential facilities. More than a dozen Chinese construction and development companies are ranked among the largest and most successful businesses in the world. But this has not always been the case. Vanke Corporation, a leader in residential construction, began as a corn trading company in 1984. In 1983, Wang Shi, the future founder of the corporation, was an employee of the Foreign Economic Cooperation Committee of Guangdong Province and was appointed head of the trade department of the State Company for the Development of the Special District of Shenzhen (Paine et al., 2018).

At the same time, he noticed that the food supply of corn to the south of China came mostly from Thailand and the United States, while there was enough corn growing in the north of China to supply all of Guangdong, Wang Shi convinced Guangdong provincial authorities to open a sea container shipping route from Dalian to Shenzhen and established a logistics, trading company independent of the committee to supply everything ″that was profitable″ from the north to south China and back. In 1988 Vanke became a ″public company″ (a limited liability organization with more than 200 shareholders but not listed on the stock exchange), with Wang as chairman and CEO. In 1988, Vanke participated in one of the first land auctions in Shenzhen and purchased 20 million yuan worth of land use rights. Thus, the first construction project of Vanke Corporation began (Paine et al., 2018).

Figure 12: Shenzhen, 1979

Source: Bryan Grogan (2019), Sina Guangdong, 1979.

Before the reform and opening up policy under the planned economy, most urban workers lived in housing provided by state-owned enterprises and by the government. The process of developing the commercial real estate market and limiting government subsidies took two decades until the early 2000s. In 1993, 95 percent of the Vanke Corporation's income came from retail sales. However, from 1993 to 1998, China experienced its first "boom" in commercial real estate construction, in which Vanke Corporation took the role of the forerunner. So, Vanke Corporation in the early 00's became the largest construction company in China, for the most part managing the development of Guangdong Province. Vanke also was the first company in China to sell not only real estate, but also property management services. Condominiums or so-called "garden areas", which usually include fenced landscaped areas with multi-level (typically 25–30 floor) residential buildings, and often villas, playgrounds, sports grounds, and swimming pools, kindergartens and schools, theme parks have become the "gold standard" for the subsequent development of the real estate market in China and completely changed the urban market (Paine et al., 2018).

Vanke Corporation's projects were based on adapting modern Japanese and European construction technologies to Chinese realities. It was also an

important issue of corporate ethics, as construction sites employed tens, hundreds of thousands of workers, it was important to organize their labor and life, so Vanke Corporation introduced a system of penalties for contractors not paying wages to workers, required contractors to provide them with family air-conditioned rooms and paid close attention not only to the construction quality, and time control, but also to working conditions of construction workers (Paine et al. 2018).

Figure 13: Vanke Office, Shenzhen

Source: Marina Shafir, 2020

The buildings, infrastructures, offices, and condominiums created by giant construction corporations such as Vanke, Country Garden, and Evergrande have changed the urban image of China and Guangdong Province in particular. Since the founding of the PRC, Chinese architecture has undergone the first wave of transformation, first, the architectural policy of the 50s–60s was "Return to the ancient", then the style of mid-rise buildings with curved roofs was popular. The period from the late 60s to early 80s was called the "new communist style" and is characterized by some cubism and panel construction, from the early 80s and especially in the 90s, the construction of multi-level "Gardens" spread throughout the country marked as

the ″Cantonese″ style of architecture. The ″Cantonese″ architectural style was based on modernism, which had already spread in Hong Kong, and then postmodernism. Straight lines, austere forms, minimalism, large spaces, freedom, lots of light and air, and the absence of rigid rules have found a lively response, in the urban direction of Chinese urban planning (Du, 2020).

Because of the large-scale high-rise construction in the mid-1980s, the expression ″the speed of Shenzhen″ (深圳速度) and later ″the Shenzhen Effect″ appeared in the literature on China's urbanization: skyscrapers were built ″marvelously fast″ , sometimes at the rate of one floor in three days. Juan Du, architect and author of ″The Shenzhen Experiment″ , states: ″Shenzhen, a unique cluster of tall buildings, became the official model of China's modernization and urbanization″ (Du, 2020). Shenzhen's construction has become so successful, that the cost per meter of real estate in the city center was growing exponentially, so developers and planners were faced with the fact that the center of the metropolis began to run out of free space for new buildings. The solution was the land reclamation – they began to use the sea to build houses, filling up the bay and continuing the accelerated development of the city (Du, 2020).

Although Shenzhen has become a purveyor of ideas and a model for China's rapid urbanization and modernization, not every Chinese city can replicate its success. Some researchers compare the ″Shenzhen Effect″ to the ″Bilbao Effect″ – as models to be copied and emulated, both of these cities remain unsurpassed because of their unique characteristics of development (Chatwin, 2020).

6.6 Shenzhen, The ″1000 Parks″ City

The idea of creating an ″ideal city of the future″ has long stirred the minds of scientists, writers, and artists. Famous examples are the ″City of the sun″ (Tommaso Campanella, 1602), the ″Garden cities of Tomorrow″ (Ebenezer Howard, 1902), and the ″Radiant City″ (Le Corbusier, 1930).

At the end of the 20th century, the development of technology made it possible to build cities in the lifetime of one generation and design real cities of the future. One of these promising projects is the garden city, a city that connects the citizen with nature as much as possible, which can be achieved with green areas of about 50% of the urban area (Sharifi, 2016).

The garden city is also characterized by the extensive development of social infrastructure. A garden city is an ergonomic, polycentric environment in which places for work, communication, recreation, and life are within walking distance of each inhabitant. Another variant of the garden city idea is ″Ecopolis″ – an urban settlement planned with the complex of human

ecological needs in mind (Sharifi, 2016).

Parks, squares, plazas with greenery, green roof terraces, or landscaped promenades – not only have a positive effect on the ecology of space and relieve pavements but also ease social tension through freedom of action and recreational opportunities and enable the integration of many cutting-edge engineering ecosystems (water filtration, rainwater collection, energy generation, etc.) into a given area of the city (Grinspan et al., 2020).

"The city of the future is a cascade of landscape projects, harmonious and interwoven with each other through engineering, interconnected like valleys and mountains, seas and coasts in a natural environment. And only then, after creating a sustainable landscape urban design can we build buildings that add to the natural harmony of homeliness" (Connolly, 2019):

The city of the future is a tamed scenic area, a natural landscape, complemented by convenient commuting routes, squares and roads, and buildings that blend seamlessly into the landscape.

Since 2006, Shenzhen's urban planners began the task of creating a three-tiered park system, which would include nature parks, city parks, and residential community parks. City parks or central parks form the green backbone of Shenzhen, community parks are created wherever possible on the outskirts of residential areas and so on, and nature parks are located around the city, such as mountain forests, coastal parks, and so on (Liu et al., 2021).

In September 2019, Yang Lei, vice head of the city's urban administration and law enforcement bureau, stated that the city met its goal of becoming a city of 1,000 parks a year ahead of its 40th birthday. The 1,090 parks are spread across the city's nearly 2,000 square kilometers of land. Among them, 118 are located in Futian District, 88 in Luohu, 47 in Yantian, 98 in Nanshan (including three in Qianhai), 180 in Bao'an, 216 in Longgang, 125 in Longhua, 46 in Pingshan, 171 in Guangming, and 42 in Dapeng, 30 of which are cross-district parks (Liu et al., 2021).

All parks are open to the public, most of them are free of charge; park walls have been removed to be integrated with the city; cultural and sports facilities in parks are constantly being improved and upgraded; nature education centers are being built to give parks a popular science function. Residents can reach a community park within 500 meters of any residence in the city, a city park within 2 kilometers, and a nature park within 5 kilometers (Liu et al., 2021).

The number of community parks in the city has reached 905, accounting for more than 80 percent of the total parks. To ensure these parks are places featuring co-construction, co-governance, and a shared environment, a campaign was launched to encourage residents to create community gardens by using green areas near their communities and to provide daily care for the

gardens.

Among these parks, Shenzhen International Garden and Flower Expo, Lotus Hill Park, and Xianhu Botanical Garden have been named "National key parks", People's Park has been named a "Moon Garden", Wutong Mountain Scenic Area has been listed as a "National scenic spot" by the State Council, Dapeng Peninsula National Geological Park is a National-level geological park, and Huaqiaocheng Wetland Park is a National-level Wetland Park. In recent years, the city has also created some high-quality parks of international standards, such as Xiangmi Park, Talent Park, Shenzhen Bay Leisure Zone, and Dasha River Ecological Promenade, which are popular among the public (Liu et al., 2021).

Additionally, the city promotes hand-built trails in nature parks to reduce potential negative impacts on the environment. The Country Trail Hand-built Project is a new ecological concept of untracked mountains and forests, building handicraft-based unpaved nature trails in natural parks and forests, reducing the use of large machinery, and eliminating uniform concrete and granite paving to meet the needs of people to enter nature and get close to nature with minimal impact on nature (Liu et al., 2021).

The construction project of the city's first hand-built footpath was launched in Meilin Park in Futian District. At the same time, there are 19 new parks under construction, and nine renovated parks have officially been reopened to the public. Shenzhen will start the "Park city planning outline" research, continue to increase the number of parks, and improve their quality to create a "World-class park city landscape". The city built 300 community gardens and 50 kilometers of countryside trails in 2020, and more than 40 new or renovated parks will be built each following year. Next, Shenzhen aims to have 1,500 parks by 2035 (Liu et al., 2021).

7 New Infrastructure Development

Infrastructure, especially economic infrastructure, has scale effects and network effects, which promote the flow of production, and improve economic growth, but also affect surrounding areas with the spillover of its region. The economic growth of one area will be extended to other nearby areas with the help of transport lines, and so some developing areas can be promoted, and economic differences can be reduced (Li et al., 2017).

The socio-economic and spatial functions of infrastructure are interlinked and form a coherent system including location, differentiation, communication, integration, morphological and managerial functions. Every active infrastructure facility, a communication line, a hub, or a transport corridor consisting of railways and roads, bridges, high-voltage power lines, underground gas, and oil pipelines, waterways, etc., simultaneously performs a variety of socio-economic and spatial functions, causing changes in the territorial, economic, community and innovative development of the region (Brennan, 2009).

The role of infrastructure in the spatial development of the territory is the "arranger" of the socio-economic space. It manifests itself in the changes in certain aspects of the territorial management of the regions and their components – population, economy, environment, industry, science, and culture (Brennan, 2009).

The concept of infrastructure includes several types (Ghosh & De, 1998):

- Social infrastructure – a set of industries and businesses that functionally provide normal livelihoods for the population. Communal services, sewerage system, telephone network, etc.;
- Transport infrastructure – the totality of industries, enterprises, construction networks of transport;
- Engineering Infrastructure – systems of engineering and technical support of buildings and constructions;
- Infrastructure of the economy – the totality of branches and types of activity servicing the production and economy as a whole;
- Information infrastructure – a system of information organizational structures, subsystems that ensure the coordination process.

The main objective of regional economic planning in the PRC is to reduce excessive disparities in the level of socio-economic development of regions. Infrastructure development differs due to the geographical location of the

areas, the level of industrialization and urbanization of the regions, and the corresponding differences in population density (Li et al., 2017).

The People's Republic of China is the world leader in investment in infrastructure projects. The distribution of capital investment across different infrastructure sectors is determined by the urgent challenges facing the country's economy. The rapid growth of the economy requires an efficient logistics system capable of providing fast and inexpensive transportation services for large volumes of both freight and passenger traffic (Li et al., 2017).

China faces extreme unevenness in the distribution of population across its territory. Southeastern coastal regions are densely populated and fairly economically developed, but most natural resources are found in the desert western and northern regions of the country. This is especially true of thermal coal, which is critical for the development of the country's energy and industry sectors (OECD, 2012).

Despite the existence of modern highways, the PRC railway and road system as a whole was extremely congested at the beginning of the 21st century due to the energy sector's dependence on coal-fired generation. Most of the cargo transported by rail was coal. Transporting coal by road caused record traffic congestion, with more than 100 km of jams in 2010 and 2011 (BBC, 2010; ECNS, 2014).

The construction of SEZs and the accelerated industrialization and urbanization of the south-east of China lead, among other things, to enormous seasonal labor migration. Many millions of people from the western provinces regularly take buses and trains to work in the southeast of the country. The peak of pressure on passenger transport occurs during the Chinese New Year, when people travel to their places of origin or tourism travels (Yang et al., 2020).

Infrastructural and urban expansion, the technological revolution, and the construction and sustenance of new modern cities require, among other things, the generation and consumption of enormous amounts of energy. A major challenge for China is to provide the economy with cheap and relatively clean energy sources – the coal-based energy system leads to environmental pollution and logistical overburdening of the transport system.

7.1 Integration Projects in the Pearl River Delta

Before the 1979 "Reform and Opening-up" policy implementation, the region on the border with Hong Kong and Macao in the Pearl River Delta was, apart from a few historically important industrial cities – Guangzhou, Huizhou, Foshan and Jiangmen – a mostly rural area full of rice paddies, banana and sugar cane plantations and fishponds (Li, 2009).

After the start of reforms, a phase of rapid urbanization and industrialization of the region's countryside began, actively attracting foreign and local investment through SEZs, open seaside cities, duty-free zones, etc. The rapid growth of industries and cities on the Hong Kong-Macau border was both the cause and effect of infrastructure development in Guangdong province and the need for the Pearl River Delta region's progressive cluster-type economic integration (Li et al., 2011).

Over time, the government planned to establish SEZs, develop Guangdong's infrastructure, and the growth of manufacturing clusters and cities in the Pearl River Delta on the borders with former colonies and later Hong Kong and Macau Special Administrative Regions (SAR), led to the creation of a grand integration plan called the Greater Bay Area (GBA), which was unveiled in 2017 and is expected to be implemented by 2035 (Routley, 2018).

However, the first attempts to integrate the designated areas under a single name began in the early 1980s. In 1985, the State Council of PRC introduced the plan for the Pearl River Delta Open Economic Region (PRDEOR), which was composed of 28 cities and county-level administrative units in the Pearl River Delta and covered an area of over 40,000 square kilometers in 1987. The 28 districts and cities of PRDEOR were subject to preferences similar to those of the SEZs, but the SEZs themselves were not included in the PRDEOR region, nor was Guangzhou Open City. In 1996, however, the Guangdong provincial government decided to correct this fact and unite all the special areas in the Pearl River Delta under the name of the Pearl River Delta Economic Region (PRDER) (Li, 2009).

In 2008, after the State Council published the Pearl River Delta Reform and Development Plan (2008–2020), the name "PRD" region came into circulation. The boundaries of the Pearl River Delta were also clearly delineated to include the nine then already large, rapidly developing industrial cities of Guangzhou, Shenzhen, Huizhou, Zhuhai, Jiangmen, Zhongshan, Dongguan, Foshan and Zhaoqing (Li, 2009).

The reform plan included the promotion of regional integration in infrastructure, urban planning, social services, environmental protection and culture among the nine PRD cities, and between the PRD, Hong Kong, and Macau. An important element in regional integration was the development of infrastructure links for fast transit. Since 2008, the Guangdong Provincial Government has invested trillions of yuan in infrastructure projects. These projects included the establishment of an extensive high-speed rail network between the PRD cities, a 400-kilometer subway was built in Guangzhou, Shenzhen, Foshan, and Dongguan. Large-scale infrastructure projects such as the Guangzhou–Shenzhen–Hong Kong Expressway, the Hong Kong Zhuhai–Macao Bridge, and the Shenzhen–Maoming Expressway were also imple-

mented between 2008 and 2020 (KPMG, 2020).

By the early tenths of the 21st century, China had become a world leader in the development and construction of large-scale infrastructure projects. In 2013, President Xi Jinping gave a vision for the creation of the Economic Silk Road Belt and the 21st Century Maritime Silk Road, and in 2015, the Action Plan of The Belt and Road Initiative (BRI) was officially published (Wong, 2018).

The idea of the Sea Silk Road in the 21st century was to create two routes. One, to connect China's coastline with Europe through the South China Sea and the Indian Ocean, and the other, China to the South Pacific region – again through the South China Sea. The South China Sea, with its largest ports in Hong Kong and Shenzhen, would be the main route of the future maritime road. The PRD region with Hong Kong and Macao is thus an essential part of the Belt and Road Initiative, providing not only maritime freight transport but also technology exports for major infrastructure projects around the world (Wong, 2018).

On the 20th eve of Hong Kong's return to the jurisdiction of the PRC, July 1, 2017, He Lifen, Chairman of the State Development and Reform Committee, Governor of Guangdong Province Ma Xingui, Head of Administrations of the HKSAR Kerri Lam, and MCSAR Administration Head Fernando Chui in the presence of the president Xi Jinping signed a Framework Agreement to deepen cooperation between the province of Guangdong and SAR Xianggang [Hong Kong] and Aomen [Macao]. The agreement was intended to promote the construction of the Greater Bay Area (GBA) (FA, 2017).

The former plans of the Pearl River Delta Region aimed at the integration of the zone, always included informally the SARs Hong Kong and Macao, but in 2017 the planning, for the first time, went beyond including both SARs with a clear commitment to integration. Besides, it was also a global statement to compete with other Greater Bay Areas in the world: Tokyo, San Francisco, and New York (Chung, 2019).

The agreement listed "Five Strategic Directions" as the main principles, directions, and mechanisms for cooperation (FA, 2017; KPMG, 2019):

- The growth of innovation and the creation of an interconnected system of innovation centers and production facilities of the GBA through increased openness;
- The use of the complementary benefits of the three administrative entities for the implementation of mutually beneficial cooperation;
- The market should play a leading role, and the state – stimulating and regulating;

- To achieve success in one sector, it is necessary to carry out a breakthrough on all others;
- The district's priority is sustainable, eco-friendly, "green" development.

The leading areas of cooperation included:

- Promotion of transport, communication, and infrastructure interconnectedness, a gradual increase in the level of market integration between the two special administrative regions and the province of Guangdong;
- Creating a coherent system for the development of the modern industry of the GBA;
- Creating in the agglomeration such living conditions that would simultaneously ensure the convenience of living, working, leisure and travel;
- Formation of the advantageous position of Hong Kong and Macau in the field of international cooperation, including cooperation with countries along the BRI;
- Support for the construction of large-scale platforms for cooperation within the GBA, such as the Hong Kong–Shenzhen Innovation and Technology Park.

It is planned to achieve the objectives by ensuring closer coordination of the work of the governing bodies of each of the administrative and territorial entities and the State Committee for Reform and Development. Four-sided consultations should be held annually at a fixed time. In addition, the expansion of participation in the creation of the GBA by representatives of broad sections of society, trade unions, and analytical centers is considered to be a mechanism for achieving the goals (FA, 2017).

One and a half years after the agreement was signed, in February 2019, a new outline plan for the development of the Greater Bay Area was announced at a meeting of the State Council of the PRC. In addition to the "Five Strategic Directions" , aimed at closer integration between the mainland, Hong Kong and Macau, it plans a calendar of desired milestones of achievements (ODP, 2019):

Table 9: The GBA cities overlook, 2022

City	Area (sq.km.)	Population (M)	GDP (BN USD)	Per Capita GDP (USD)
Guangzhou	7,434	18.81	429.32	22,840
Shenzhen	1,997	17.68	482.15	27,250
Zhuhai	1,736	2.47	60.22	24,370
Zhaoqing	14,891	4.13	40.27	9,750
Huizhou	11,347	6.07	80.41	13,260
Jiangmen	9,507	4.84	56.17	11,620
Dongguan	2,460	10.54	166.74	15,880
Foshan	3,798	9.61	189.04	19,904
Zhongshan	1,784	4.47	54.06	12,150
Macao SAR	33	0.67	22.73	33,784
Hong Kong SAR	1,110	7.33	362.44	49,464
The GBA total	56,098	86.62	1,943.54	22,585

Source: Author based on HKTDC Research, Census and Statistics Department of Hong Kong, Statistics and Census Service of Macao, the Statistics Bureau of the relevant PRD cities, HKTDC, 2022.

- By 2022, the basis for a world-class GBA urban cluster should be formed. Regional development should become more coordinated by this date;
- By 2035, markets in the GBA should be closely linked, and effective flows of various resources and factors of production should be established;
- Hong Kong, Macau, Shenzhen, and Guangzhou will be the key cities in the GBA. The government will enhance the status of Hong Kong as an international financial, transport, and shopping center, as well as an international aviation hub. Macau will become a global tourist destination and a platform for trade with Portuguese-speaking countries, such as Brazil. Guangzhou will play a leading role as the provincial capital. Shenzhen will play the role of a Special Economic Zone where the main Chinese innovation and technology enterprises are based (ODP, 2019).

Figure 14: The GBA Cities Positions, and Roles.

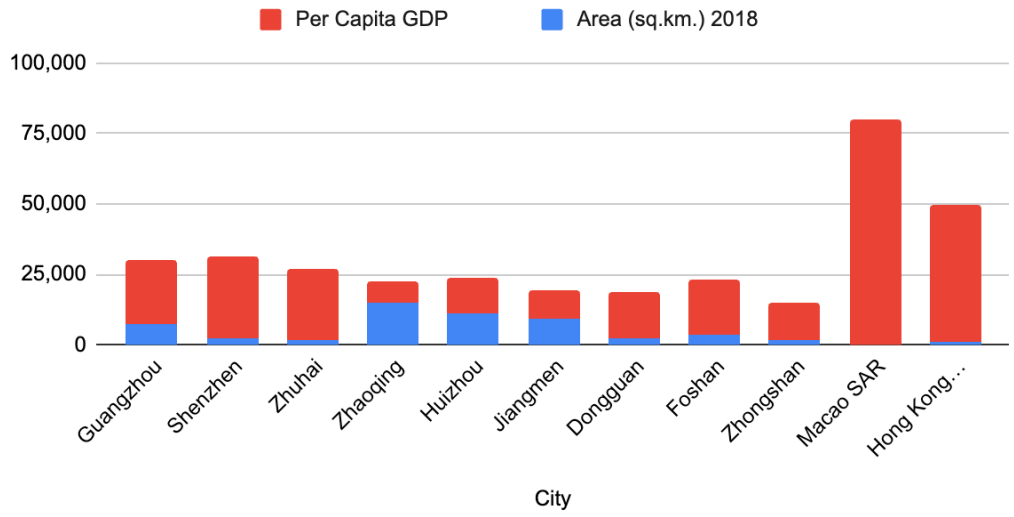
Source: Colliers International (CI, 2019).

The cost of the plan ranges from $3.2 to $4.1 trillion. And if this plan is implemented, the GDP of the agglomeration will double by 2035. The standard of living of the population of the region will exceed the standard of living of the developed first-tier countries. The Greater Bay Area will be the most highly developed, high-tech and highly urbanized area on the planet (Wong, 2018).

7.2 New Infrastructure Development

In 1949, China had only 22,000 km of poorly maintained and war-damaged railways, of which less than 1,000 km were double track; electrified railways were virtually non-existent. Since then, the Chinese government has expanded the country's rail network more than fivefold and has made significant changes in the quality and capacity of its own rail sector (Koll, 2019).

Figure 15: GBA cities Area (sq.km.) and per capita GDP (USD), 2018.



Source: Author based on HKTDC Research, Census and Statistics Department of Hong Kong, Statistics and Census Service of Macao, the Statistics Bureau of the relevant PRD cities, HKTDC, 2019a.

Over the past two decades, Chinese railways have constantly faced two major challenges: expanding infrastructure and improving its quality; and reforming the industry to ensure that it can adapt and survive in today's ever-changing market economy. To meet the challenge of improving infrastructure, China embarked on the world's largest railway construction programme since the nineteenth century (Koll, 2019).

In January 2004, the State Council approved the Medium and Long-Term Railway Development Plan, defining construction priorities and a framework for developing five-year plans. In 2004, funding for the Plan amounted to ¥1.7 trillion for the period up to 2020 (at 2004 prices). At the end of 2015, the network had been extended to 121,000 kilometers, more than half of the network consisted of double track roads and more than 60 percent had been electrified. In mid-2016, an updated China Railways development plan was released with the aim of expanding the network to 175,000 km by 2025. Currently, the length of the PRC's railways is about half the length of all high-speed rail lines in the world (Yu et al., 2018).

An important part of the success of the PRC's infrastructure development was the administrative reform of the railways, which took place in several stages and was designed to increase the profitability of rail transport. In

the 1990s, China Railways' non-core activities, including construction, manufacturing, telecommunications, engineering, education, and social functions, were separated from the core business. Over the next fifteen years, the number of staff in the railway sector fell by a third and traffic volume increased by 60%, more than doubling average employee productivity (Koll, 2019).

In 1999, the System of Operational Responsibility for Assets (SOEA) was introduced and regional railway authority managers became responsible for return on capital, performance, profitability and safety. Under the SOEA, managers are responsible for operating and enhancing the assets assigned to them; there are rewards for those who exceed the agreed targets. All members of regional railway management teams, up to and including station chiefs, have been required to pay a "motivation deposit" according to their rank; the deposit is withheld if targets and commitments are not met. If managers meet targets in excess, their deposits are returned and they receive a bonus, the amount of which can be almost double the value of the deposit. The financial performance of regional railway authorities has gradually improved since the introduction of SOEA, as has the overall financial performance of China Railways. In addition, safety performance has improved significantly, and the number of accidents has decreased (Koll, 2019).

In 2013, the National Development and Reform Commission (NDRC) outlined three principles for the reform of China's railway industry (Koll, 2019; Lawrence et al., 2019):

- Separating state management from enterprise management;
- Creating a competitive environment where necessary;
- Improving the efficiency of industry management.

This reform was implemented with two main objectives:

- Maintaining the financial sustainability of the sector to meet its development goals;
- Enhancing the capacity of the railway operator to respond to market competition in both passenger and freight transport.

The government undertook a major restructuring of the railway sector by eliminating the Ministry of Railways and removing the management of railways from the list of government functions. The move was a confirmation of the government's strategy to separate regulatory and administrative responsibilities from commercial operations, as well as its intention to keep rail assets centralized in China (Koll, 2019; Lawrence et al., 2019).

In January 2010, China's first high-speed line (over 350 km/h) was opened between Wuhan and Guangzhou, stretching 961 kilometers. Today, more than 1,330 rail routes are operated daily throughout the country. Most railways in China are used for both heavy freight and fast passenger trains, except for new dedicated high-speed passenger lines and dedicated lines in mining areas. These lines generally operate at seven or eight-minute intervals and typically carry 120 pairs of passenger trains a day (equivalent) and up to 180 pairs during peak periods, such as the Spring Festival, which is close to their theoretical capacity (Koll, 2019; Lawrence et al., 2019).

In terms of international logistics, a joint venture called YuXinOu was set up by China Railway Corporation in 2012 to provide and regulate rail freight transport between China and Europe. As part of the 2015 Belt and Road Initiative, which focused on connecting China to Eurasia, China is transporting freight via the China-Europe Railway Express (CR Express) network. This Chinese railway network links container terminals between China and more than eight countries, including Germany and, more recently, the UK. In 2016, China and the Intergovernmental Organization for International Railways (ORIF) signed a memorandum of understanding to identify areas for future cooperation, including regulations, technical standards and the introduction of a common consignment note for freight transport between Asia and Europe (Arduino, 2016).

A renewed plan to expand the high-speed line network to 30,000 km by 2020, which would connect 80% of China's major cities, was also approved in late 2016. The plan similarly includes the expansion of the traditional railway network by 20,000 km by 2025. Eight regional intercity lines between cities and towns are already in successful operation. Implementation of the plan was designed in particular to create high-speed links between Hong Kong, Guangzhou, and Shenzhen in the Pearl River Delta (Koll, 2019; Lawrence et al., 2019).

Figure 16: The GBA Infrastructure Railway Connections.

Source: Colliers International (CI, 2019).

The first railway between Hong Kong (Kowloon) and Guangzhou via Shenzhen (Luohu) – the Kowloon Canton Railway (KCR) was put into operation as early as 1911. The journey from Hong Kong to Guangzhou by KCR took five and a half hours. Modernization of the line began in the 1990s, and its first phase was connected with the introduction of the Kowloon-Beijing route in 1998. After the modernization of the railway, the journey time from Kowloon to Guangzhou has dropped to two hours. The next stage was the large-scale construction of a high-speed railway line to link Hong Kong and Guangzhou via Shenzhen (Koll, 2019).

This high-speed railway was built from 2005 to 2018 and is divided into two sections. The first section is on the mainland China side between Guangzhou and Shenzhen (广深 Guang Shen). The Guang-Shen road section connects Guangzhou, Dongguan, and Shenzhen. The full length is 116 kilometers and the travel time to Futian Station in Shenzhen is 36 minutes. Trains with speeds of up to 350 km/hour run along this section (Eden, 2018).

Construction was carried out by the Guangdong Provincial Government

and the Ministry of Railways of China (since 2013 by the China Railway Corporation). At the end of 2011, the main part of the road from Guangzhou South Station to Shenzhen North Station was opened. The remaining section to Futian was supposed to be completed in 2012, but it was opened 3 years later due to difficulties encountered (Koll, 2019; Lawrence et al., 2019).

In addition to the construction of modern high-speed train hubs – Guangzhou South and Shenzhen North terminals, three other major stations have been built – Dongchun, Humen and Guangming. Guangzhou South Terminal in Panyu District was built in 2010 and was the largest railway station in Asia at the time (Eden, 2018).

Figure 17: The Guangzhou South Terminal.

Source: Photo by Alexander Shafir, 2020.

In Shenzhen, the city's largest hub was also built in 2011 in the Longhua district, connected to the Xiamen expressway, which continues to Shanghai as the Coastal High-Speed Passenger Line, the city underground, and later to the Shenzhen–Zhangjiang line and on to Hong Kong and Hainan. In the process of road construction, the 10.8 km Shijiang Tunnel under the Pearl River between Dongchun and Humen stations was built (Xin, 2017).

The second section of the railway route is on the Hong Kong side covering 26.5 km and is integrated with the overall network of its city metro. Construction of the section started in 2010 and was scheduled to be completed in five years. However, continuous delays have made the project more expen-

sive, and the search for additional funding has slowed down the construction process even further. As a result, the final cost of the project, which was implemented by MTR Corporation of Hong Kong, rose to $10.8 billion. Thus, laying one kilometer of track cost $415 million, which was a world record (Xin, 2017).

This is explained by the fact that the entire route was laid underground and in mountain tunnels. Even the terminus at the western end of the Kowloon Peninsula, the 11-hectare Kowloon West Railway Station, was built underground. To build it, 4.5 million cubic meters of earth had to be dug up. It was not possible to build the track on the surface because of the density of construction in Hong Kong, which made it impossible to build the station and the tracks leading to it without demolishing a lot of buildings (Wang et al., 2018).

However, construction of the massive railway line and infrastructure facilities was finally completed in 2018, resulting in a more than halving of rail travel times between Hong Kong, Shenzhen and Guangzhou (Lawrence at el., 2019):

- Hong Kong (West Kowloon/International) – Shenzhen–Futian: 14 minutes;
- Hong Kong (West Kowloon/International) – Shenzhen (North): 19 minutes (fastest);
- Hong Kong (West Kowloon/International) – Guangzhou (South): 47 minutes;

7.3 Linking Strands – the Development of Steel Bridge Building in the PRC

Since ancient times, China has been called the "Kingdom of Bridges". More than 1,400 years ago famous architectural monuments were built, such as the Zhaozhou Bridge in Hebei. Today, bridge-building technology in China is on a global scale. China builds thousands of bridges a year, and their total number has exceeded one million (Xinhua, 2019b).

There are currently 21 cable-stayed bridges with spans of 600 m or more in the world. Seventeen of them are in China. In addition, of the twelve arched bridges with a span of more than 420 m that currently exist in the world, nine are also located in China (Zhou et al., 2021). It wasn't until 1991 that the 423 m long Nanpu Bridge was successfully built. The 602 m long Shanghai Bridge was opened two years later over the Pujiang River. The

construction of these bridges marked the beginning of the era of large-span bridges in China (Feng, 2009).

China Road and Bridge Corporation (CRBC) was established, at a time when bridge construction required technical assistance from foreign countries and imported steel. Now, CRBC can construct more than 120 bridges of various types simultaneously all over the world (Zhou et al., 2021).

Behind the construction of large bridges is the development of industry – production and technology. Before the construction of the Yangzi River Bridge in Nanjing in 1968, China did not have its own bridge steel – all of it was imported from abroad (Feng, 2009).

In 1978 Chinese Vice-Premier Deng Xiaoping flew to Japan to conclude the historic peace treaty between the two countries. During the visit, he visited a state-of-the-art factory owned by Japan's Nippon Steel Corporation. The Japanese steel plant was the prototype for the construction of Baosteel's manufacturing base in Shanghai. Steel has become a key element in China's plans to transform itself from an agrarian country to an industrial one (Yap, 2018). In 1978, China produced only 4% of the world's steel. In 2018, experts estimate that China produced more than half – a record 923 million tons. It overtook the US in steel production in 1993, Japan in 1996, and in 2017 produced three times as much steel as the US, Russia, and Japan combined. Steel has turned China's bridge building, shipbuilding, automotive, and railway construction industries into the largest in the world (Feng, 2009; Yap, 2018).

Until the late 1990s, China imposed an export limit of 10 percent on the steel it produced. Steel production also required a maritime transport network for imported iron ore and coal. The development of steel production required the expansion of the infrastructure network of railways, and the construction of new bridges, transport vessels, containers, cranes, and trucks (Feng, 2009; Yap, 2018). Before the WTO accession in 2001, the limit on steel exports was lifted. Today, Chinese steel exports account for a quarter of the world's overall steel exports. State-owned steel plants now exist in all 23 Chinese provinces (Feng, 2009; Yap, 2018).

Over the past 40 years, Chinese bridge building has gone through three phases: 1) learning how to build; 2) striving to catch up, and 3) surpassing the leaders. The implementation of the Belt and Road Initiative opened up new opportunities for China's participation in building other countries' infrastructure, and "Smart Chinese-made bridges" are in demand all over the world. China Road and Bridge Corporation (CRBC) and China Communications Construction Company (CCCC) are responsible for the construction of more than 50 major bridges abroad. They guarantee reasonable prices, innovative technology, and reliable quality (See Table 11) (Zhou et al., 2021).

Table 11: The PRC Bridges Export Projects

Project	Country	Year	Comments
The San Francisco–Oakland Bay Bridge	USA	2013	Constructed by Shanghai Zhenhua Heavy Industries, it is a single-girder, self-propelled, earthquake-resistant suspension bridge. At that time was the longest span of any similar steel structure in the world.
The Second Bridge in Penang	Malaysia	2014	Made by China Harbor Engineering Company (CHEC). The project involved applying intelligent construction engineering to enable the successful erection of the 240-meter (787-feet) main span cable-stayed bridge, then the longest sea bridge in Southeast Asia.
The Zemun–Bolza Bridge	Serbia	2014	Was the first construction carried out by Chinese companies (CCCC and CBRC) in Central and Eastern Europe.
The Mohammed VI Bridge	Morocco	2016	Then the largest cable-stayed bridge in Africa, this bridge is referred to by locals as the "Bridge of Dreams" and was constructed by the CCCC Company.
The Salvador-Itaparica island Bridge	Brazil	Est. 2022	The longest cable sea bridge in Latin America is going to be constructed by the CCCC and the CBRC companies.

Author own elaboration.

Currently, the CRBC has built more than 3,000 bridges in China. In October 2018, the Hong Kong–Zhuhai–Macau Bridge (HZMB), was completed. This bridge, along with the high-speed railway line linking Guangzhou South to Kowloon West, the Human (1998) and Nansha (2019) bridges, and the future railway bridge linking Shenzhen Airport to Zhongshan (expected in

2024) are the main connecting, transport, and logistics arteries of the Greater Bay Area Project (See Figure 18) (Huang, 2018).

Figure 18: The GBA main bridges and rail projects.

Source: Colliers International (CI, 2019).

The HZMB is one of the most technically complex projects in the history of Chinese engineering. The construction of this bridge is seen as a symbol of overcoming the forces of nature, of overcoming the dividing factors. A film about the construction of the bridge was broadcasted several times on Chinese central TV channels (Xue et al., 2020).

Figure 19: The Hong Kong–Zhuhai–Macau Bridge (HZMB).

Source: Shenzhen Urbanism and Reform Museum, 2020.

The HZMB is a project consisting of a series of bridges and underwater tunnels that cross the Pearl River Delta, as well as access flyovers and crossing points. The bridges and tunnels on the project connect Hong Kong, Zhuhai, and Macau – the region's biggest cities – and are designed to withstand earthquakes and typhoons, using 400,000 tons of steel. The main part of the bridge is 29.6 km long, including a 6.7 km underwater tunnel, a 22.9 km main bridge, and three cable-stayed bridge sections with spans ranging from 280 to 460 meters. The bridge, built in the shape of a Latin letter "Y", reduced the travel time between Hong Kong and Zhuhai from three hours to 30 minutes (See Figure 19) (Xue et al., 2020).

Table 13: Recent Infrastructure Projects in the GBA.

Project	Description	Extent
Guangzhou–Shenzhen–Hong Kong Express Rail Link	A train line at a speed of 350 km per hour allows to get from Hong Kong to Shenzhen in 14 minutes, and to Guangzhou in 48 minutes	142 km
Hong Kong–Zhuhai–Macau Bridge	The longest sea bridge in the world, connecting Hong Kong with Macau and Zhuhai, allows it to get from Hong Kong to the mainland in half an hour	55 km
Nansha Bridge	A suspension bridge crossing the Pearl River. It is also the beginning of the Guangzhou–Longchuan Expressway. The bridge is part of the expressway network connecting the Shatian town of Dongguan to the Nansha district of Guangzhou, the Guangzhou ring expressway, and the Guangshen Yanjiang expressway	13 km
Shenzhen–Zhongshan Bridge	The future bridge will connect two major cities Zhongshan and Shenzhen. It will consist of a series of bridges and tunnels, starting from Bao'an International Airport on the Shenzhen side. The proposed plan is scheduled to be completed in 2024	51 km

Source: Author based on HKTDC, 2019a.

7.4 The Metro Network as an Engine of Urban Development. The Case of Shenzhen

The metro lines have a special role in the development of modern megacities. Initially, subways were built to relieve the pressure on the streets of large cities; nowadays, the metro has become the main structural element of the modern city, which forms the basis for the population's mobility. The main advantages of the metro as an off-street mode of transport are high (up to 150

km/h) speed and regularity of trains with intervals up to 80 s, which together determine the carrying capacity of more than 50,000 people per hour in one direction. With appropriate development of the city's transport network and transport organization, the underground limits commuting time to within 15% of working time, which meets the fundamental efficiency criteria of urban transport (Katz and Bradley, 2013).

The metro is the most efficient form of urban passenger transport also in terms of energy consumption and occupied space. The implementation of an energy recovery mechanism for braking (recuperation) on the underground also provides tangible savings (Katz and Bradley, 2013).

The metro network plays a key role in the development of infrastructural integration. The construction and expansion of the metro network in all Chinese cities is a major transport, urban planning, and social policy objective, all of which determine the standard of living and mobility of the population (Yeh et al., 2015).

The integration of individual modes of transport into a single complex is facilitated by improving and simplifying the fare system. At the same time, the introduction of smart cards, electronic payment applications integrated with WeChat, Alipay, and Baidu services which can be used not only to pay for travel by different means of transport but also to design and monitor the best route, and the development of various automated passenger information systems before and during journeys certainly contribute to the attractiveness and convenience of using public transport. The smooth operation of these services is made possible by the effective coordination of modern software and the development of innovative networks (Bulanda–Jansen, 2019).

Among all modes of urban transport, the metro is at the forefront of introducing innovative technologies aimed at operational reliability and simplifying maintenance. For example, the introduction of driverless automatic train driving leads to improved productivity, safety, and service regularity (Yeh et al., 2015).

While essentially a key link in urban mobility systems, metros remain complex and costly engineering structures that require large amounts of money to build and maintain. Therefore, in addition to classic budget financing methods, all stakeholders are creating new partnership-based schemes. Such schemes may include tax incentives from the state, preferential land use rights in the area of line routes and station locations, inclusion of construction participants as major shareholders, as well as various methods of public-private partnership formation (Katz and Bradley, 2013). In the case of the Shenzhen Metro, Real and Property (R+P) Development was a form of such partnership.

R+P as a development practice is relevant to the concept of transit-

oriented development. While the latter refers to the planning practice that emphasizes clustered development around transit stations, the R+P model goes a step further by creating a joint development of transit infrastructure and real estate and by allowing the metro operator to participate in the relevant real estate projects. The term R+P was first used to describe the involvement of the Hong Kong Mass Transit Railway Corporation (MTRC) in real estate development around stations. The R+P model has been used in Hong Kong SAR as a value-capture tool to finance railway infrastructure. Under the R+P model, the MTRC acquires the right to develop land around or above each railway station at the market price based on the ″greenfield″site value and sells or leases the completed development projects at the market price after the rail station is built. Due to the accessibility and agglomeration benefits brought by railway projects, MTRC can capture the land value increment. This approach is well suited to financing rail infrastructure and advancing transit-oriented development in the rapidly growing cities of mainland China, where many cities, including Shenzhen, have imitated this joint development model (Yang et al., 2020).

Thus in 2017, the developer of the Shenzhen metropolitan area, the leader in the construction and operation of rail transit in the city, Shenzhen Metro Group Co. Ltd. founded in 1998, became a major shareholder in one of the most important construction companies in southern China, Vanke Corporation (Ce, 2017).

In 1994, Shenzhen organized the preparation of the ″master plan of Shenzhen Urban Railway Network″ which was part of the ″master plan of Shenzhen City Development 1996–2010″ . The city's vision for the urban underground network consisted of nine lines. Of the nine transit lines, three were planned as interurban railway lines, upgraded from the existing national mainline railways. The total length of the proposed network was to be about 270 km (Bulanda–Jansen, 2019).

A special feature of the Shenzhen Metro was its initial focus on cross-border travel to Hong Kong, which was to increase in demand after Hong Kong's return to PRC jurisdiction in 1997. The first two lines consisted of 23 stations with one interchange in Convention and Exhibition Center were built from the two border crossings, Luohu Checkpoint Station and Futian Checkpoint Station, the last one was constructed by Hong Kong MTR corporation (Bulanda–Jansen, 2019).

Figure 20: Shenzhen Rapid Transit System Map, 2004.

Source: Shenzhen Metro Corporation-SZMC, 2004.

Construction of the first sections of Line 1 and Line 4 began in 1999. The opening of the Shenzhen Metro system was at the end of 2004. This made Shenzhen the seventh city in mainland China to have a subway after Beijing, Tianjin, Shanghai, Guangzhou, Dalian, and Wuhan. Initially, the trains operated at 15-minute frequencies and consisted of Line 1 services between Luohu and Shijie Zhi Chuang (now Window of the World) and Line 4 services between Fumin and Shaonian Gong (See Figure 20) (now Children's Palace) (Yeh et al., 2015).

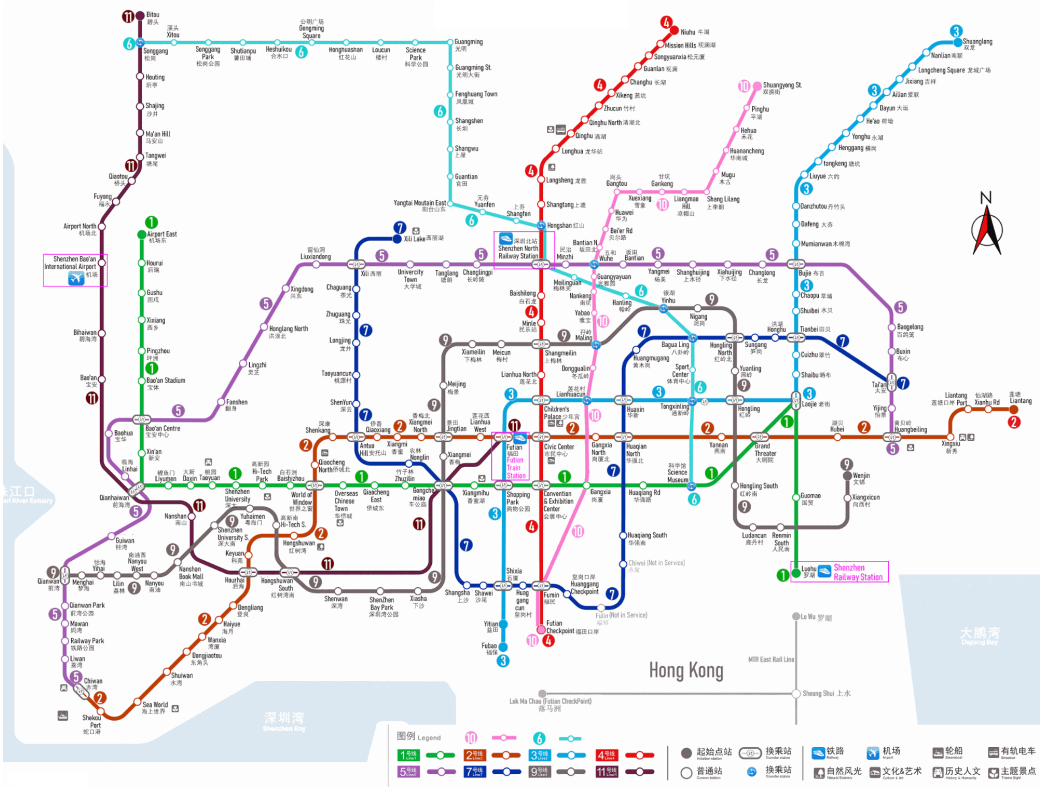
In January 2007 Shenzhen won to host the 2011 Universiade and committed to complete 155 km of subway lines before the games. The Shenzhen municipal government and various departments signed a liability form, requiring Phase II subway expansion to be completed in time for the Universiade. Shenzhen Metro increased to over a hundred operating metro stations in June 2011, just before the Shenzhen Universiade games (RT, 2013).

Another major factor affecting Shenzhen's metropolitan network plans was the size change of its administrative area. Before 2010, Shenzhen consisted of the four districts of Nanshan, Futian, Luohu, and Yantian – these areas of 395 square kilometers were informally designated as Guannei (关内) and subsequently became the city center. During the administrative transformation of 2010–2012, three more districts Baoan, Guangming, and Longgang, previously considered suburbs and designated as Guanwai (关外), were incorporated into Shenzhen's city boundaries. This increased the area of the city fivefold to 1,948 square kilometers in 2012 (Huang & Xie, 2012; Song et al., 2020).

With the unveiling of China's global Belt and Road initiative in 2015 and the active development of the Greater Bay Area urban cluster plan to link

the nine cities in the Pearl River Delta with Hong Kong and Macao, new developments are underway for Shenzhen's metro, rail network and infrastructure facilities. In the plans to build the GBA, Shenzhen is given the role of leading city and central transport hub to link the infrastructures of all the other 10 cities (Du, 2020).

Figure 21: Shenzhen Metro System Map, 2021.



Source: Shenzhen Metro Corporation-SZMC, 2021.

In 2021, Shenzhen's underground is 455 km long, with 11 lines in operation and 283 stations, and has surpassed London in the number of stations. Today the city is at the biggest growth phase of the project, and by 2022 at least half of the total planned network will have been built. Daily passenger flow is at a maximum of around 6.5 million people (See Figure 21)(SZMC, 2021).

Along with the MTR the Intercity rail is being given a high priority, too, as many Shenzhen residents are living further from the current urban borders due to rising living costs. In 2019, about 1.36 million trips were made from Shenzhen to neighboring Dongguan and Huizhou, but this is expected to

increase to 6.2 million per day by 2035 (Wang, 2018). The total area of the Shenzhen Metro should reach 1,335 square kilometers, the number of lines will be increased eight-fold from 2004 and four-fold from 2018 to 33 by 2035, with eight of those 33 lines expected to be express lines (Wang, 2018).

7.5 China's Urban Infrastructure Innovations – Maglevs, Hydrogen Corridors, and Autonomous Transport

Changes in the transport and urban infrastructure of China's main big cities illustrate the development of innovative technologies or, as they are commonly referred to, ″technologies of the future″ . China provides a springboard for testing and adapting global innovations to its needs by developing the science and technology sector. It contributes to the globalization and generalization of scientific and technological progress (Sheehan, 2020).

One of such technologies is the ultra-high-speed innovative trains on magnetic levitation (Maglev) capable of reaching speeds of up to 600 kilometers per hour. The technology for using magnetic suspension in railway traffic was developed by various researchers during the 20th century, one of them was the German company ″Transrapid″ , which developed the idea of magnetic levitation rail tracks in the late 1960s. Transrapid allows higher speeds and gradients with less weathering and lower energy consumption and maintenance needs. Its track is more flexible, and more easily adapted to specific geographical circumstances than a classical train system. The vehicle is limited to a maximum payload of 15 tons (14.8 long tons; 16.5 short tons) per car (MAGLEV, 2020).

Transrapid technology as part of the urban infrastructure was first put into circulation in Shanghai, with the route between Pudong Airport and Longyang Subway Station launched in 2002. Passengers cover a thirty-kilometer stretch in seven minutes at speeds of up to 431 km per hour (MAGLEV, 2020).

In 2019, China's State Council unveiled the National Outline for Building a Powerful Transportation Country. The Ministry of Transport in 2020 proposed to develop intelligent high-speed EMUs, and carry out the development and testing of high-speed maglev trains with a speed of 600 kilometers per hour and high-speed wheel-rail passenger trains with a speed of 400 kilometers per hour. The construction and development of a network of high-speed maglevs connecting the main Chinese megacities of Beijing and Shanghai with Guangzhou and Shenzhen as well as with Chengdu and Wuhan is a major part of this plan (Seetao, 2020).

China's largest railway company CRC announced in June 2020 that a prototype maglev capable of reaching speeds of up to 600 kilometers per hour has been developed and successfully tested at Shanghai Tongji University. The maglev tests were part of the "Advanced Rail Transit" of the National Key Research and Development Programme of the Ministry of Science and Technology. Development of the prototype has been underway since 2016 and in 2020 it finally passed ground commissioning and static tests, so the vehicle entered the line dynamic operation test (Chan, 2021).

The success of this test run marks an important breakthrough in the PRC's high-speed maglev R&D and also provides important technical support for the subsequent development and optimizations of high-speed maglev engineering prototype vehicles. According to reports, the 600 kilometers per hour high-speed maglev project prototype is expected to roll off the assembly line at the end of 2020. In 2021, a full set of high-speed maglev technology and engineering capabilities will be formed. After having the engineering capability it could be mass-produced (Chan, 2021).

The Guangdong Province's department of natural resources has also outlined plans for the construction of several maglev lines with a total length of 1,000 km to connect the south China province with Beijing and Shanghai (Chan, 2021). When fully constructed in 2030, the new maglev lines will cut travel time from Shenzhen and Guangzhou to Shanghai or Wuhan to two and a half hours. Meanwhile, the travel by maglev from Shenzhen and Guangzhou to Beijing will require just over three hours, the current travel time by HSR from Guangzhou to Beijing is 8 to 10 hours (Briginshaw, 2019).

The Development and Reform Commission of Shenzhen has already issued a feasibility plan for a second high-speed rail parallel to the existing Guangzhou–Shenzhen line. The Guangzhou–Shenzhen high-speed maglev intercity railway planning study will analyze possible routes as well as viability. The line is planned to include a connection between Shenzhen Bao'an International Airport, and Guangzhou Baiyun International Airport in under 20 minutes (See Figure 22) (MAGLEV, 2020). Another innovation in the development of China's transport infrastructure is the gradual shift from classic transport power sources to carbon-neutral ones. Until recently, China has been extremely dependent on the global market and had to import up to 70 percent of the oil consumed in the country. In addition, transport powered by petrol and diesel pollutes the environment (Jin & He, 2020).

Figure 22: Maglev 2030 Guangzhou to Shenzhen Section Plan.

Source: The Guangzhou Shenzhen Maglev (MAGLEV, 2020).

Since 2009, China's central and provincial governments have launched a massive campaign to support and subsidize manufacturers of vehicles powered by new energy sources. The first "Ten Cities, Thousand Vehicles program" (十城千辆工程 shi cheng qian liang gongcheng) was launched in 2009 and targeted 10 pilot cities to deploy at least 1,000 New Energy Vehicles (NEV) with a one-time purchase subsidy from the central government. That program grew significantly over the ensuing years in terms of the number of cities and vehicle types covered, and it drove the uptake of the Plug-in Electric Vehicles (PEV) market. Starting with only a few hundred PEVs in 2009, China has now become the largest PEV market in the world and currently has a stock of over 3 million (Jin & He, 2020).

Besides, transportation electrification is the most accessible and cost-

effective clean transportation solution with the highest energy conversion rate. Thanks to the rapid development of batteries in the past few years, transportation electrification has expanded from railways to light vehicles, small ships, and even shorter-range airplanes (See Figure 23) (Liu and Wang, 2021).

Figure 23: Electric Scooter Charging Modules in Shenzhen.

Source: Photo by Marina Shafir, 2021.

In 2020, China's Association of Automobile Experts said that by 2035, the country will no longer sell vehicles powered only by petrol or diesel. According to the association's plans, in 15 years, 50 percent of all new vehicles should work on "clean energy" – electric or fuel cell (hydrogen) – and the other 50 percent should be hybrid vehicles combining internal combustion engines with other types of propulsion systems. The plan is led by China's Ministry of Industry and Information Technology and will serve as the basis for legislative and policy decisions on road transport (Tu, 2020).

In 2019, "clean energy"vehicles accounted for 5 percent of all new car sales in China. According to government plans, the ratio will gradually increase until it reaches 50 percent by 2035. In this category of vehicles, more than 95 percent of new cars must be electric by that date (Tu, 2020). As for hybrid

cars, it is expected that by 2030, 75 percent of all new internal combustion engine vehicles will be hybrid. Finally, from 2035, gasoline or diesel will only be consumed in new cars if they are hybrid cars. Purely petrol or diesel new cars will not be sold in China from 2035 (Liu and Wang, 2021). By comparison, hybrid and electric cars accounted for 39 percent of new car sales in Japan in 2019. According to the Japanese government's plans, this figure should increase to 50–70 percent by 2030 (Liu and Wang, 2021).

Starting in 2019, the country's central and local governments switched from subsidizing the production of PEV to providing subsidies for the establishment of hydrogen fueling stations and the production of parts for Fuel Cell Vehicles (FCV). Hydrogen as an energy source in a national law signifies its strategic importance. Hydrogen can be produced renewably and can play a major role in decarbonizing transportation. The FCV is one key application of hydrogen energy, but it's also useful in other transport sectors such as rail, air, and sea. Although less efficient than PEVs, FCVs can more easily displace conventional vehicles when fast refueling, heavy loads, or very long trips are required (Jin and He, 2020).

Chinese manufacturers of load transport – buses and trucks – rely predominantly on imported components. First and foremost, Japanese fuel cell supplies are the leaders in this field: Honda Motor, and Toyota Motor. Japanese companies are afraid of technology leakage and are not going to build fuel cell factories in China, and so the Chinese authorities have started supporting local businesses to develop the production of components on-site (Tu, 2020).

The government's new initiative means funding large-scale infrastructure projects to create "hydrogen transport corridors" for "new energy" vehicles. Above all, these are fueling stations that charge fuel-cell vehicles with hydrogen. For China, this is not only an environmental improvement – fuel-cell engines emit water instead of gasoline or diesel combustion products – but it also reduces its dependence on oil supplies, plus hydrogen is abundant in China as a by-product of steel and chemical production (Jin and He, 2020).

According to the plan, in 15 years new FCV will account for up to 5 percent of vehicle sales annually. Hydrogen fuel cells are expected to equip urban public transport and freight vehicles, which is in the hands of the city authorities. China's central and provincial governments are going to provide city governments with subsidies of up to 1.7 billion yuan ($253 million) over four years to develop hydrogen corridors (Liu & Wang, 2021).

In addition to the production of PEV, China is trying to integrate the production of smart-vehicles with the growth of the information technologies of smart-cities. The development of robotics and autonomous urban transport is also an important part of the latter (Ng, 2020).

Figure 24: Autonomous Street Washer in Futian district, Shenzhen.

Source: Photo by Marina Shafir, 2020.

The year 2018 began the commercialization for autonomous driving. Based on Baidu's Apollo autonomous driving system, they designed seven vehicles to fulfill various indoor and outdoor tasks, such as sweeping roads or public areas, and collecting and transporting garbage. The vehicles were put to work in shopping malls, high-speed rail stations, airports, venues, squares, industrial parks, pedestrian roads, and community spaces (See Figure 24) (Fan, 2019).

In 2019 was launched the first fully self-drive bus on a short roundabout route in the Smart Island Special District of Zhengzhou. And in December, 2020, a robot taxi with no test drivers at the wheel and no remote operators was tested in the central district of Shenzhen (Ng, 2020). From 2020 the autonomous robots and vehicles aided by sensors such as LiDAR and

powered by AI are aiding the municipal services, public safety authorities, health authorities, and businesses in China while the COVID-19 hit regions (Vardhan, 2020).

CRUZR, a Cloud-Based Intelligent Service Robot from UBTECH Robotics, Inc., along with a patrol car version, was on the streets of Shenzhen in spring 2020. These robots helped the police fight COVID — 19 by working at toll gates to monitor mask use, and body temps with infrared thermometers, and further allowing police to communicate through a speaker to minimize contact with people (See Figure 25) (Vardhan, 2020).

Figure 25: Cloud-Based Intelligent Service Robot (CRUZR) in Yantian District, Shenzhen.

Source: Photo by Marina Shafir, 2021.

The year 2020 also marked the development and further adoption of robot taxi technology in China. Previously, companies using driverless cars on public roads in the country were limited by strict regulations that required a "back-up" driver to be inside. But in 2020, the laws changed. In Shenzhen, AutoX removed the driver and remote operator control from the taxi interior for a fleet of 25 vehicles. The government has not territorially restricted AutoX's operations, although the company stated that the vehicles were

concentrated in the city center of Shenzhen (Ng, 2020).

In the launch video, the startup's minivan, the Fiat Chrysler Pacifica, navigates through the city center on its own, showing passengers getting in or loading packages in the back seat. The car detours around forklifts, passes pedestrians, and performs U-turns (Ng, 2020). AutoX was founded in 2016, a Shenzhen-based startup focused on creating unmanned car technology and collaborating with major automakers such as Fiat Chrysler (Sun, 2021).

The new autonomous car program is still in test mode and is currently closed to the public. In 2020, the coronavirus pandemic saw a rise in demand for non-contact services, which spurred the development of autonomous technology. In June 2020, Didi, China's largest ride-hailing company, began offering free rides in driverless cars in a designated area of Shanghai (Sun, 2021).

Tech giant Baidu formally launched a Robo-taxi service in Changsha, as part of its Apollo program. Not all companies have been immune from the lasting impact of COVID-19 outside China. Baidu and start-up Pony.ai both have a presence in the US, for research and testing had to suspend testing in California, but by then the company had already resumed testing in China. The access to China's traffic data can be useful for training its algorithms (Shepherd, 2020).

AutoX planned to double the presence of its self-drive vehicles in more than 10 Chinese cities. Whether the company can launch fully unmanned vehicles in other markets depends on local regulators. In Shanghai, driverless rides are available to all users who can order them through the Alibaba Autonavi app (Ng, 2020).

China, home to the world's largest automotive sector, could become the world's leading market for autonomous vehicles, according to a report by consultancy McKinsey. The country is projected to generate up to $1.1 trillion in revenue from unmanned transportation services by 2040 (Pizzuto et al., 2019).

Innovative Technology, however, still has a long way to go. However, the development of autonomous car transport, along with the construction of high-speed railways and the switch to alternative energy sources are already indispensable parts of all the Chinese government's infrastructure plans (Sun, 2021).

8 The GBA and Sustainable Green Urbanism

According to the integration concept of the quintuple helix and the principles of the innovation economy, an integral component of the RIS is the environment, which should be:

- Sustainable;
- Green;
- Infrastructurally convenient and interlinked with other components of the helix.

Chinese national and local urban planners in the GBA are introducing smart, green city systems, clean electric and hydrogen transportations, sponge city concept, and developing green infrastructure. More about which in detail below.

8.1 New Strategies for Sustainable Development and Green Urbanism

"Green Urbanism" is the practice of creating a habitat that is human-friendly and harmonious with the environment, sustainable, and consumes minimal resources. Green Urbanism is an interdisciplinary effort, combining the cooperation of government, urban planners, landscape architects, engineers, ecologists, transport planners, physicists, psychologists, sociologists, economists and other specialists (Pow & Neo, 2015).

The PRC has been a member of the United Nations Environment Programme (UNEP) since 1972, and in 1987 UNEP established the headquarters of the International Training Center against Desertion in Lanzhou. Through UNEP, China has partnered with international organizations such as the World Bank, the Asian Development Bank, and the Global Environment Facility (Luo, 1999).

The ideas of "Green Urbanism" became widespread with the publication of the UN doctrine of "Sustainable development", which was adopted in 1987 by the World Commission on Environment and Development (WCED).

"Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is not about quantitative growth, but about qualitative change, establishing harmony between nature, economy and society" (Luo, 1999).

In the second half of the 20th century, China was undergoing intensive industrialization, which led to the degradation of natural resources and widespread environmental pollution in most regions. An important milestone in the development of environmental consciousness in the PRC occurred in the 1990s. In addition to organizing the UN Conference of Heads of Ministries of Developing Countries on Environmental Protection in Beijing (1991), the PRC was an active participant in the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, where it presented the "Report on Environment and Development" . The report included a description of the problems facing the PRC in the second half of the 20th century – air pollution caused by coal combustion, industrial pollution, contradictions between rapid urbanization and backward urban infrastructure and their impact on the environment, and many others (Li, 2006).

PRC acknowledged that the country has severe environmental problems and lags far behind developed countries. The report also pointed to the backwardness of technical equipment for dealing with environmental problems. The fact that much of China's industry caused pollution made it impossible to reduce resource intensity and increase efficiency. Moreover, at that time China could only spend 0.7 percent of its GDP on such issues, and raising this percentage was not feasible because of the low GDP per capita (Luo, 1999).

In 2002, China participated in the UN World Summit on Sustainable Development in Johannesburg. By signing the Johannesburg Declaration, the PRC agreed not only to provide the conditions for sustainable development, but also to address environmental concerns. For the PRC the cornerstone of the declaration was a commitment to a transition to a "Greener Economy" . However, the declaration lacked a clear definition of the details and timing of the goal (Li, 2006).

In March 2007, former Prime Minister Wen Jiabao said that the Chinese economy was becoming increasingly "Unstable, unbalanced, uncoordinated and unsustainable" (Xinhua, 2007). This sparked a lively debate about "sustainability risks" , but the Chinese government has nevertheless started to develop an "environmental vision" to adjust plans for the next five-year period and develop a new reform program. The country's leaders concluded that the Chinese economy could no longer afford to remain energy-intensive and to further follow the kind of aggressive industrial expansion established in the early 1980s. The massive industrialization has created an environmental disaster and a rapid increase in greenhouse gas emissions (Meidan, 2020).

The main directions of China's new environmental policy were formed in Hu Jintao's report at the 17th Congress of the CPC Central Committee in

October, 2007 and contain the following provisions (CDIC, 2007):

- Regulating and optimizing the development of the country's regions, taking into account the ecological, demographic and social conditions of the region;
- Development of the marine ecosystem;
- Conserving resources while increasing resource utilization efficiency: not only conserving resources and seeking alternative sources of energy but implementing energy-saving advanced technologies to increase the utilization rate of coal energy from 20 percent to at least 50 percent.

The basis for improving the effectiveness of sustainable development measures is an environmental information system. China began developing an environmental information system as early as the mid-1980s. Between 2006 and 2010, a three-tiered management system consisting of national, provincial, and municipal institutions was established. In the same period, the infrastructure for an information network covering environmental protection offices across the country was set up. Some systems were deployed for environmental quality monitoring and pollution sourcing, environmental emergency and complaint management, collection of pollution fees, assessment and approval of construction projects. As a result, a system of data analysis at national, provincial, municipal, and sectoral levels is now in place, covering all areas of environmental quality such as pollution, ecosystems, nuclear, and radiation safety conditions and environmental management. The main institutions and agencies dealing with environmental information are listed in the table below (Kostka et al., 2020):

In March 2015, the PRC published a strategic planning document on "Sustainable Development". "The Position of the CPC Central Committee and the State Council of the PRC on Accelerating the Construction of an Ecological Civilization" of the 18th CPC Congress. The "Position" declares that the Chinese leadership is aware that without solving major environmental problems, the country, despite its economic and political successes, will face a catastrophic collapse, and it is not far off. The upcoming idea behind the "Reform and Opening-up" policy should be to mainstream ecological values and objectives into all aspects of society's development and people's education. The goals of "Ecological Civilisation" and the previously stated "Middle-Income Socialist Society" will be mutually adaptable. The position proposes 10 rigorous measures for establishing a system of ecological responsibility and new environmental standards (Meidan, 2020).

Table 15: Key Agents of the PRC Environmental Government.

Year	Name	Comments
1998–2008	State Environmental Protection Administration (SEPA)	A ministry-level agency, the part of the State Council. In 2006, SEPA opened five regional centers to help with local inspections and enforcement. Today, the five centers are direct affiliates of MEE
2008–2018 2018–Present	Ministry of Environmental Protection of the People's Republic of China (MEP) Ministry of Ecology and Environment (MEE)	There are 12 offices and departments under MEE. They carry out regulatory tasks in different areas and make sure that the agency is functioning accordingly.
1954–Present	Ministry of Water Resources (MWR)	The part of China's Central People's Government consists of 20 departments responsible for managing water resources in China.
2001–Present	Chinese Academy of Environmental Planning (CAEP)	A leading think tank for Chinese environmental protection administration in the new era.
1980–Present	China National Environmental Monitoring Center (CNEMC)	The part of MEE, rendering technical guidance on national environmental monitoring.
2012–Present	China National Renewable Energy Center (CNREC)	The National Renewable Energy Research and Development Centre has been established as part of a Sino-Danish government program.

Source: Author own elaboration.

They concern energy efficiency, resource-saving technologies, zero-waste production, ecological zoning of territories, setting the limits of permissible

load on nature, introducing ecological criteria into the system of certification of civil servants of all levels, etc. In total, the Position contains 30 tasks and this document is considered as a ″road map″ for state planning in the field of sustainable development and Green Urbanism. The PRC's concept of ″Ecological Civilisation″ as well as the UN Environment Programme 2015–2030 include the following sustainable development goals (Xinhua, 2015):

- Ensuring sustainable consumption and production patterns;
- Taking urgent action to combat climate change and its effects;
- Conservation and sustainable use of the oceans, seas and marine resources for sustainable development;
- Protecting, restoring and promoting sustainable use of terrestrial ecosystems, rational management of forests;
- Combating desertification, halting and reversing land degradation and halting biodiversity loss.

Also in 2014–2015, several significant changes were made to the Law on Environmental Protection, marking a new stage in the development of China's environmental policy (Pang, 2020):

- Providing a legal basis for compulsory environmental protection without abandoning economic development. By raising the principle of sustainable development to the legal sphere, the government shows its determination to make environmental protection a fundamental strategic national policy;
- A monitoring responsibility and evaluation system for the public officers is established. In this way, local governments motivate public officials to do a better job of protecting the environment;
- A system of sanctions for companies for exceeding pollution limits has been established. A Penalty and the fine system have been set up;
- Provision is made for the disclosure of information related to the Green Economy. That is, the public has the right to know and monitor public institutions and polluting companies. Companies must also publish information on emissions (name of pollutants, emitting methods, density and total amount of pollutants, excessive emissions, and information on pollution prevention means).

Ecological Civilization must develop through a "Green and Circular Economy" – an economic activity "that supports well-being and social equity while significantly reducing environmental risks and ecological damage. "Green and Circular Economy" is a type of economic activity in which income growth and employment are generated through public and private investment, leading to reductions in greenhouse gas emissions and pollution (Chi, 2021). The circular economy aims to change the classic linear model of production by focusing on products and services that reduce waste and other types of pollution. The basic principles of the Circular Economy are based on resource renewal, recycling, and a shift from fossil fuels to renewable energy sources (Chi, 2021).

This type of economy is also seen as part of the Quintuple Helix innovation Economy model and the Fourth Industrial Revolution, aimed to improve the connections between people and the environment and to ensure rational use of resources, including natural resources, and make the economy more transparent, predictable, rapid and systematic (Thorsten, 2011).

The reasons to switch to a "Green and Circular Economy" are not only to improve the environmental situation, but also due to the greatest possible economic benefits: a circular economy in the long term can significantly reduce the cost of production.

The number of international, national, and regional initiatives and projects in the field of ecology and Green Urbanism included in the national five-year plans has grown exponentially and has tripled in the decade from 2011 to 2021 (Holzmann & Grünberg, 2021).

The basic national strategy for building the ecological civilization of the future includes to reach the carbon neutrality and the transition from classic to renewable energy sources (RES). The commonwealth of AI technologies in the field of urban management SMART cities developing ecological infrastructure such as the project "Sponge Cities", zero-waste, smart waste sorting, and recycling. It also includes the concepts of "Beautiful China" and "Green Gold" aimed at beautifying and greening areas of cities and transforming rural areas into eco-sanctuaries and national parks.

A 2019 NASA environmental study concluded that between 2000 and 2017, China accounted for more than a quarter of the new green space created globally, making its contribution the largest in the field. China's outsized contribution comes in large part from its programs to conserve and expand forests (about 42 percent of the greening contribution). These programs were developed to reduce the effects of soil erosion, air pollution, and climate change (Tabor, 2019).

In 2019, China launched the "Belt and Road International Green Development Coalition" to facilitate the implementation of the UN 2030 Agenda

for Sustainable Development.

"We call on all countries to strive for innovative, coordinated, green, and inclusive development for all, to seize the historic opportunities presented by a new round of scientific and technological revolution and industrial transformation, to achieve an environmentally friendly global economic recovery in the post-coronavirus era and thus create a powerful driving force for sustainable development" , Xi Jinping said at its launch. (CRI, 2019).

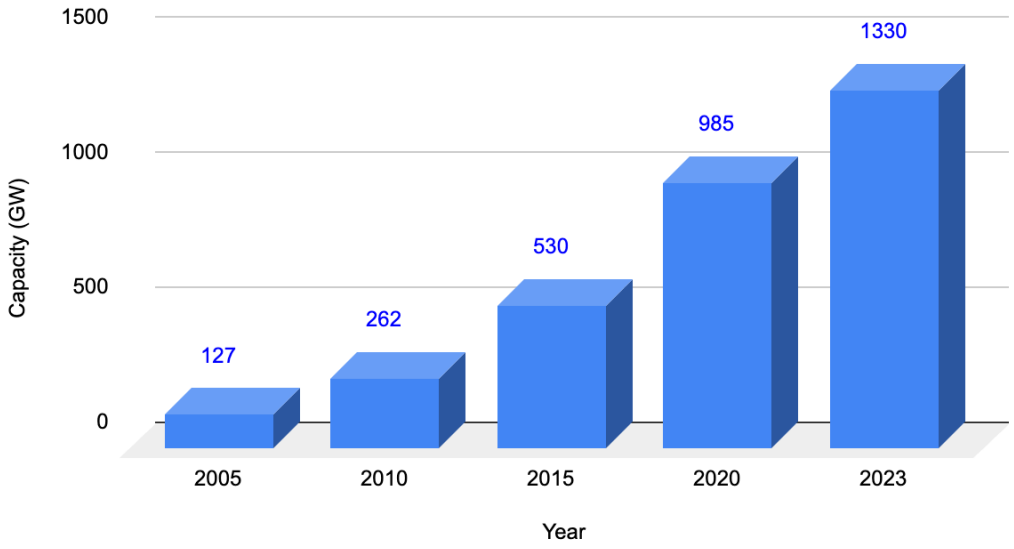
In September 2020, Chinese President Xi Jinping, speaking at the 75th session of the UN General Assembly, promised to "reach peak CO2 emissions by 2030 and achieve carbon neutrality by 2060" (Frangoul, 2020).

China is the world's largest energy consumer and produces more than a quarter of all carbon emissions every year. This makes the country one of the leaders in pollution. "Humanity must embark on an ecological revolution and move faster towards an environmentally friendly model of development and lifestyle" , said Xi Jinping. The Chinese leader's statement means that by mid-century China is going to switch to RES and will offset any carbon emissions with its green policies (Frangoul, 2020).

Xi Jinping's plan "reflects China's determination to take international responsibility for tackling climate change" , says Li Zheng, executive vice president of the Institute of Climate Change and Sustainable Development at Tsinghua University. Flooding in major river basins, increased heat waves, rising sea levels and chronically polluted air in industrial cities have all long had a serious negative impact on China's people's quality of life. As global warming continues, China will experience more rainfall and flooding, which will pose a serious threat to its coastal cities. China is still in the process of economic development, and energy consumption will continue to rise, which in the PRC's case relies heavily on coal. Achieving carbon neutrality in this environment will be very difficult" , notes Li Zheng (Gupta, 2020).

This goal puts China on a par with the European Union, the UK, and those countries hoping to achieve carbon neutrality as early as 2050, which the Intergovernmental Panel on Climate Change says is necessary to prevent global warming of more than 1.5 degrees Celsius. Unless countries succeed in stopping climate change, the number of extreme events on the planet, such as heat waves, which negatively affect human health, will continue to increase. This also threatens climate anomalies, fires, floods, natural disasters, and the loss of animal species. (Guterres, 2020).

Figure 26: Capacity Growth (GW) of China's Non-fossil Power Generation, 2005–2023.



Source: Author based on different sources.

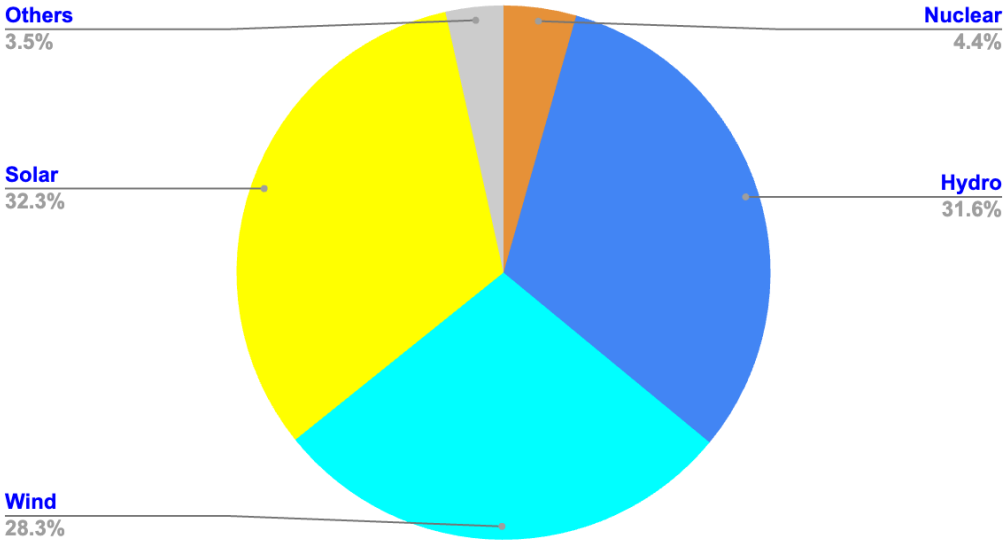
The PRC government is already trying to make a difference in key environmental sectors, for example through the widespread use of electric transport or by working with renewable energy sources. China's main challenge now is to clean up its steel and cement industries. The furnaces needed to make steel and cement typically use coke – recycled, high-quality coal. Steel production alone accounts for 15 percent of China's carbon dioxide emissions, so finding alternatives to coal is crucial. The solution could be "green hydrogen", which is widely used in Japanese and European plants. However, it also requires considerable energy capacity (Frangoul, 2020).

China needs to overhaul its energy system, which cannot but affect global markets. Fossil fuels (oil, coal, natural gas) currently account for 85 percent of the country's energy sources. To achieve carbon neutrality by 2060, China needs to reduce this figure to 15 percent. This requires large-scale investments in renewable energy sources and the phase-out of coal-fired power plants (Ambrose, 2020).

So, China is gradually shifting to alternative RES. It is already leading the world in introducing alternative, non-carbon RES, such as wind, solar, geothermal, tidal, and biomass generation. In 2018, energy consumption from RES in China was 38 percent higher than in the United States and three times higher than in Germany. Although the RES accounted for only 4

percent of China's total primary energy consumption in 2018, over the past several years, renewable energy generation has grown at a rate of at least 25 percent annually (including a 29 percent increase in 2018). If China stays on this path, the share of RES will rise to 20 percent of China's total primary energy consumption by 2025. However, according to a report by the Energy Transmission Commission, RES must increase almost 15-fold to meet the 2060 target (Zhang et al., 2020).

Figure 27: Non-Fossil Energy Sources in the PRC, 2023.



Source: Author based on different sources.

The share increase of renewable energy, particularly wind and solar power, has contributed to reducing emissions, and it plays a vital role in greening China's energy supply. The Chinese government has invested more than 2,5 trillion yuan ($361 billion) in new energy-related sectors between 2016 and 2020, most of which was invested in renewable energy projects and enterprises, excluding hydropower (Tu, 2020).

In 10 years, China has made unprecedented advances in solar water heating. It accounts for half of total renewable energy use. By 2020, solar water heating had replaced 122 million tons of coal, equivalent to a reduction of 262 million tons of CO. Since 2003, the PRC has seen growth in the solar PV manufacturing industry. Domestic solar cell production reached 1.2 gigawatts (GW) in 2006, and already in 2008 China overtook Japan and

Europe to become the largest solar cell producer worldwide (Gulzar et al., 2020).

China's transport sector is also undergoing a significant transformation. In 2009, China overtook the US in terms of the number of cars in the country (about 170 million cars), and in the same year the first clean-energy transport campaign was rolled out. The campaign was a response to environmental and social problems such as air pollution, and congestion on roads and highways, leading to poor health in megacities. In 2009, the Chinese government was aiming for "new energy vehicles", including hybrid electric vehicles, to account for about 10 percent of all vehicles in the country. Ten years later in 2019, China peaked production of PEV vehicles and set a new goal for the transport sector to develop hydrogen-fuelled vehicles – FCVs. The government's new goal is to phase out all production of engines powered solely by classical energy sources in the country by 2035. The main challenge now is not urban transport, but aviation and maritime freight transport (Tu, 2020).

A pilot scheme aimed at switching to clean public transport was launched in 2009, with Shenzhen being chosen as one of thirteen participating cities. Since then, the metropolis has taken active steps to electrify its bus and taxi fleet. In 2017, the city government allocated $430 million in subsidies for the purchase of electric buses and charging stations (Zhang et al., 2021a).

The scheme in Shenzhen was completed on schedule and already in 2019, all 17000 city buses were running on electricity instead of diesel. One of the main suppliers of new buses is BYD, whose name stands for Build Your Dreams, a company headquartered in Xi'an, Shaanxi province, but founded in Shenzhen in 2003 (Zhang et al., 2021a). One of the most famous e-buses in Shenzhen is BYD's K8. Drivers generally prefer battery buses because of their lower center of gravity. Most drivers say the new battery buses "look like sports cars" compared to the previous diesel buses (Zhang et al., 2021a). Shenzhen buses now save 345,000 tons of fuel per year and reduce carbon dioxide emissions by 1.35 million tons. Electric taxis will save another 116,000 tons of fuel per year and reduce CO2 emissions by 454 tons (E360, 2018).

In 2020, out of 21,700 city taxis, almost 21,500 were powered by electricity. In early 2018, there were still at least 7,500 petrol-powered taxis in Shenzhen. Taxi drivers were originally unwilling to embrace the vehicle replacement scheme, because they worried that the charging time would cut their driving time short. However, the city administration has been persistent in its ambition to become the largest city in the PRC with "only electric taxis driving on the streets". Remarkably, with just 100 charging stations in 2010, by the end of 2018, Shenzhen had already built a network of 8,000 electric charging stations consisting of 40.000 charging points (Zhang et al.,

2021a).

The red cabs were fully replaced by BYD's model E6. To improve the efficiency of electric taxis, given the limited mileage on a single charge, each electric taxi in Shenzhen was connected to 5G and equipped with an onboard terminal that tells drivers where their services are currently most in demand. The technology has been developed with Huawei Corporation and is part of Shenzhen's Smart City Transport Initiative. This is done both to accurately record fares and the best route option. According to the Shenzhen Transport Committee, this will prevent drivers from overcharging or using a "longer" route (Zhao, 2021).

Today China's rapidly changing transport model is also a key component of its sustainable development strategy. The country has the world's largest high-speed rail network, the fastest growing metro system, and produces the most PEVs (Plug-in Electric Vehicles) and PHEVsv (Plug-in Hybrid Vehicles). Sales of PEVs already surpassed the 500,000-vehicle mark back in 2017, compared to just under 200,000 units in the US and Europe (Tu, 2020).

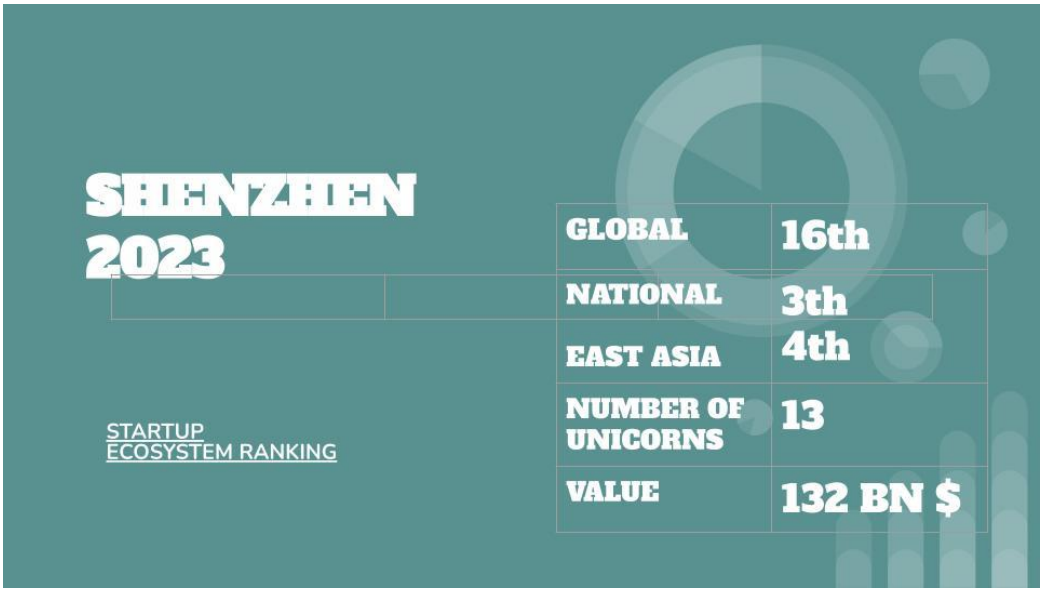
High-speed rail is one of the most energy-efficient ways to organize intercity communications. China's CO2 emissions per unit of GDP have been reduced by almost half compared to 2005, enabling early targets of a 40–45 percent reduction in emissions by 2020 compared to 2005 levels. And the 2030 target is for CO2 emissions per unit of GDP to be reduced by 60–65 percent compared to 2005 levels, with CO2 emissions reaching their peak by 2030 (Li et al., 2020).

8.2 Innovations in the Service of Sustainability

Innovativeness is the process of introducing innovations into global and regional economic and urban systems. Innovations are understood here as the results of application and dissemination of new knowledge, inventions, fruits of scientific, technical and creative efforts. The signs of system innovativeness are (Atkinson, 2014, 2021; Baccarne et al, 2016):

- Novelty (emergence of new properties and improvement of object parameters);
- Demand (in various spheres of the system);
- Feasibility (absence of restrictions on the use of new knowledge: resource, production-technological, moral, environmental, etc.);
- Availability of sustainable useful effect (improvement of key parameters of Global, National and Regional Innovation Systems).

Figure 28: Shenzhen StartUp Ecosystem Ranking, 2023.



Source: Author based on GSER, 2023.

The innovativeness of the GBA RIS can be assessed using the following criteria:

1. The quantity of startups, their growth rate and the presence of successful entrepreneurial ecosystems.

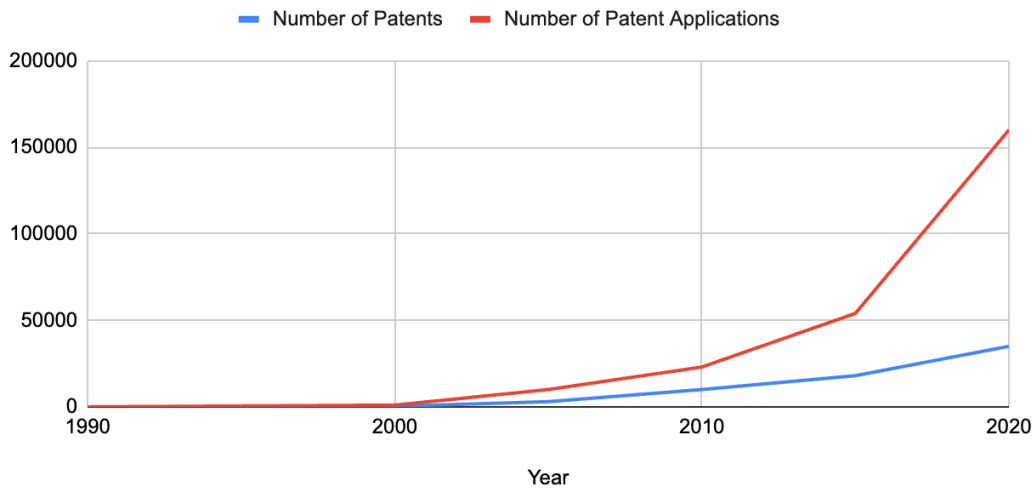
   The concentration of venture capital, local and foreign S&T talent in the GBA provides a strong startup ecosystem. Shenzhen and Hong Kong are among the top 50 cities in the world according to the Global Startup Ecosystem Index Reports 2019–2023. Growth through innovation and technology is a new trend in the development of the global economy. The GBA RIS and in particular the city of Shenzhen also serves as a strategic business platform and technology marketplace in Asia and is part of a growing local R&D cluster. According to the Global Innovation Indexes 2019–2023, it ranks 2–4 in the world in terms of knowledge, patents and scientific publications (GSER, 2023).

2. Patents: The number of patents filed and granted in a region.

   A synonym for innovation is novelty, which is always based on improvement or invention. An invention is a new solution to a problem that can be protected by patents. Patents protect the interests of inventors

whose technologies are useful and commercially successful by allowing the inventor to control the use of their invention.

Figure 29: Number of Patents and Patents Applications in Shenzhen, 1990–2020.



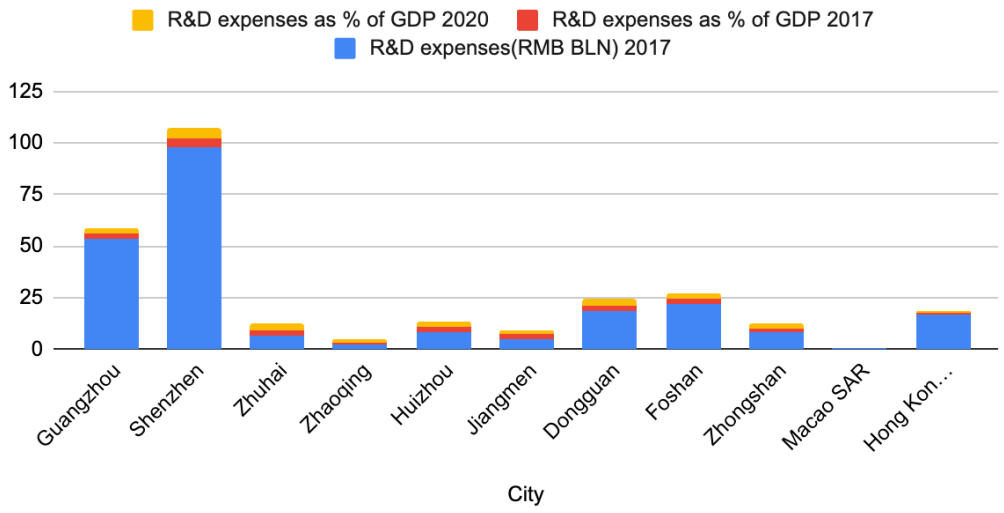
Source: Author based on different sources.

In the ten years from 2009 to 2019, China ranked first in the world in the number of all types of patents, overtaking the United States in 2019. In the same year, Shenzhen city ranked first in China in the number of both patents obtained and patent applications filed, especially in IT and innovative technologies (WIPO, 2020). There were 106.3 invention patents for every 10,000 residents in Shenzhen in 2019, which is eight times the national average. Shenzhen's Nanshan district had an average of 396.9 invention patents for every 10,000 residents, putting it in first place in China. The number of international PCT applications filed by the city in 2019 was 17,459, ranking it first among major Chinese cities for 16 consecutive years and accounting for 30.6 percent of applications from China and 70.6 percent from Guangdong province and those numbers keep going up(WIPO,2019; Li & Rigby, 2023).

3. Research and Development (R&D) investment: The amount of investment dedicated to R&D within the region, both by public and private sectors. In the ten years since 2011, R&D spending in Shenzhen has

grown at double-digit rates, with average annual growth exceeding 15 percent. In 2020, Shenzhen ranked second after Beijing among all PRC cities and first among all 11 cities in the GBA, with Guangzhou in the lead. Since the launch of the project, R&D subsidies have continued to increase over the years and account for an increasing percentage of the total GDP (LegCo, 2022).

Figure 30: GBA cities R&D Expenses, 2017–2020.



Source: Author based on Statistical Yearbooks.

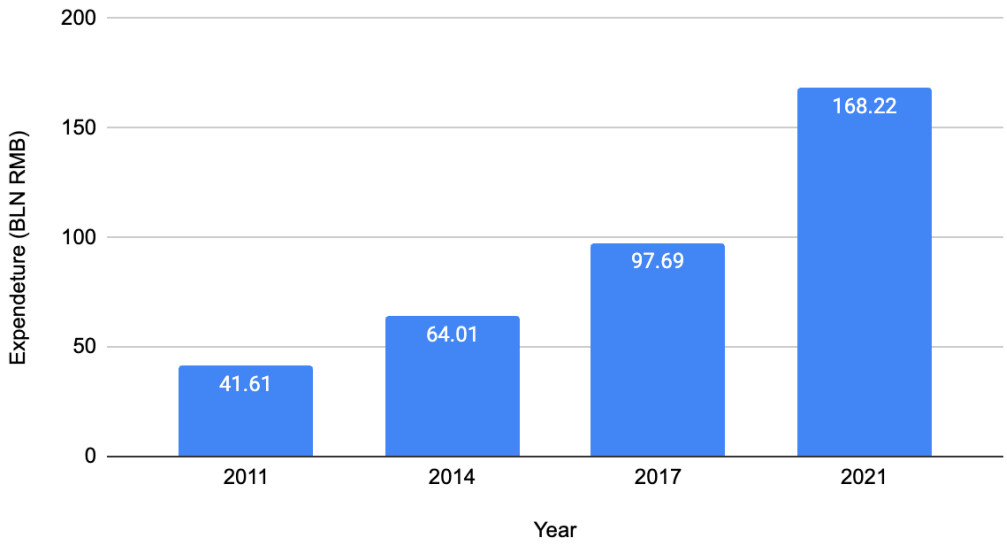
8.3 "SMART" Urban Conceptions of the Regional Innovation System

In the early 1970s, Peter Ferdinand Drucker introduced the term "SMART" in relation to management. It was originally an abbreviation of five words – the elements of effective management: Specific, Measurable, Achievable, Realistic, and Time (Drucker, 1973).

This acronym has been used in relation to the management of cities, and the ideas of "Smart cities" are being actively developed in the 21st century in close connection with the sustainability and digitalization of the economy and society. The basis of a smart city is an open and efficient management based on the application of innovative technologies that are used wisely by city residents. But this concept does not end only with the idea of the introduction and application of technologies and innovations. The idea of a

smart city, first of all, represents a new way to improve the quality of life within the city, and to create conditions for the growth of human capital.

Figure 31: R&D Expenditure Shenzhen, 2011–2021.



Source: Author based on Statistical Yearbooks.

This concept is the basis for the vision described in 2007 by the Center for Regional Science at the Vienna University of Technology. According to which it accumulates some elements within the urban area, such as (Giffinger et al., 2007):

- "Smart Economy (competitiveness): productivity, new products, services, business models, international cooperation; flexibility.
- "Smart Mobility"(Transport and Information and Communication Technology (ICT)): integrated transport systems; sustainable modes of transport.
- "Smart Environment" (natural resources): energy efficiency; renewable energy; green urbanism, environmental protection; resource conservation.
- "Smart People"(social and human capital): skilled ICT users, accessible learning, social participation, entrepreneurship.

- ″Smart Lifestyles″ (quality of life): smart consumption, convenient planning, social interaction, healthy lifestyles.
- ″Smart Governance″ (participation): citizen involvement in decision-making, user-friendly services, open data.

″The Smart City″ is being developed integrally in each of the six areas. According to the European Parliament, the concept is designed to address many pressing issues today, such as global overpopulation, high energy consumption, inefficient resource allocation and depletion, overall environmental degradation, population poverty, unemployment, social inequality, etc. (EP, 2021).

According to a 2015 report by the International Organization for Standardization (ISO) – a smart city is resilient, meaning that today's generation can meet its needs without jeopardizing this opportunity for future generations. This report also refers to the ability to regenerate, which implies adaptability to change (Ritchie, 2015).

The PRC, since 2006 has been moving towards building an ″Ecological Civilization″ and transforming the country into a ″National Innovation System″ (NIS) based on the development of a digital economy and emphasizing the importance of using AI and big data systems. By some estimates, there were more than 1,000 smart city projects around the world in 2016, and half of them were already in China (Deloitte, 2018).

These figures indicate that the concept of smart cities is widespread, announced, planned, or under construction. However, this is only an approximate number, as real, accurate data is difficult to collect due to wide variations in the definition of the concept and the criteria used to designate a smart city. As of 2019, more than 700 Chinese cities have proposed or announced transitions to the smart city government reports or development strategies for 2019 (Hu, 2019a).

Europe, North America, Singapore, Japan, and South Korea are leading the way in smart city development, but China, which joined the initiative later, has already caught up and is now leading the way in smart cities. In the past decade, the smart city movement spread across China, starting with the regional innovation systems (RIS) clusters of the coastal cities of the Greater Bay Area, Shanghai and the Hangzhou Bay Area, and the Bohai Bay Area, and to inland at a rapid pace (Hu, 2019a)

As defined in the 13th Five-Year Plan, a smart city is

″an innovative concept in urban planning that shapes the region's green future and lays the foundation for economic growth with the fundamental feature of using intelligent information processing systems to provide a sustainable human-knowledge connection″ (Xinhua, 2016).

The following positive effects of a smart city are highlighted in the 13th FYP (Xinhua, 2016):

- Increased quality of life of the population and higher satisfaction with the results of the authorities' work;
- Increased investment attractiveness of the territory;
- Efficient use of resources;
- Efficient management of territory and property;
- Migration growth.

During the implementation of the Smart City concept, researchers from the U.S.–China Economic and Security Review Commission identify several components that reduce costs and risks, which, when considered, can be expected to successfully implement the concept in practice (Atha et al., 2020):

- A team capable of interacting effectively with business and the non-profit sector and integrating management decisions at different levels;
- A systems approach. The ability to consider all elements of systems, their interrelationships, the ability to anticipate changes in them, and the ability to influence each other;
- The ability to evaluate results from different perspectives, to apply a multidisciplinary approach, to consider the interests of all stakeholders, to develop a coherent development strategy;
- The ability to adapt to change; taking a holistic approach to decision-making;
- The ability to effectively manage large volumes of data, ensure information security; facilitate the dissemination of innovations.

The main principles of the smart city concept are (Atha et al., 2020; Hu, 2019a):

- Human-contentedness and human needs, human involvement in the management of the city;
- Comfortable and safe urban environment, reliability and manageability of the city infrastructure;
- Involvement of all interested parties and coordination of their interests;

- Multipurpose use of the city physical infrastructure facilities, sensor data and monitoring systems of the city objects and various information systems;
- Focus on meeting the needs of the population and business, sustainable development; continuous improvement of management processes in the smart city based on the results of self-analysis and feedback from the society;
- Widespread use of modern technologies for analysis and processing of big data;
- Comprehensiveness and systematics of Smart City creation and development;
- Safety and reliability of smart city systems functioning.

In addition to the government, the main actors contributing to the development of smart cities are large corporations or digital platforms providing smart city technologies. In China, there are more than a thousand such "platforms", the largest of which are Huawei, Tencent, Alibaba, ZTE, Baidu, Xiaomi, Didi, and Meituan. Most of the tech giants companies responsible for introducing AI and city automation technologies are located in Shenzhen and Hangzhou, the "Silicon Valleys" of the PRC (AskCI, 2019).

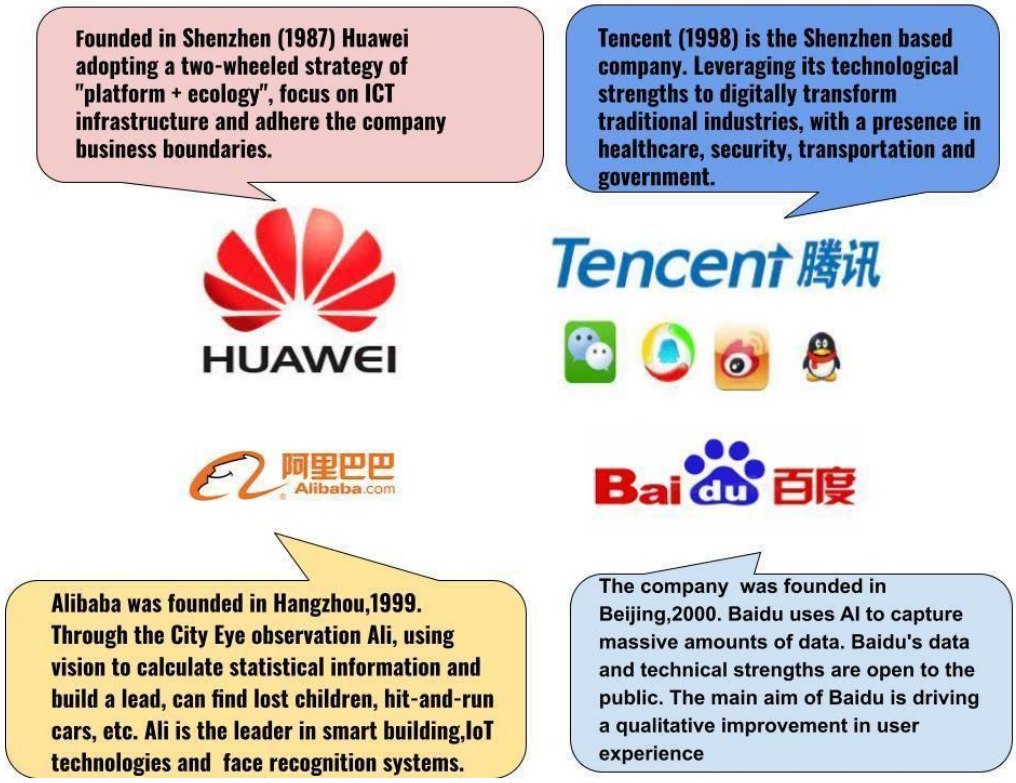
According to a 2018 Shanghai survey, the most important positive effect of smart city initiatives has been digital technologies and platforms, namely the introduction of smart finance and the ubiquitous use of digital platforms, with "68 percent of Shanghai respondents were most positive about electronic payment technologies and online services" (Slotta, 2020).

In 2020, Shenzhen was named a "demonstration city" and the flagship of China's high-tech development, because had taken on the role of China's "smartest" city. According to technical director of the smart city project at Shenzhen Ping An Bank – "AI will do most of the hard work instead of people". They have developed the mobile app "iShenzhen". It serves more than 8,000 government administrative issues, from paying utility bills and traffic fines to managing housing benefits and even participating in the central bank's digital currency lottery (Fei, 2021).

Every smart city needs greater efficiency. For example, traffic lights change according to traffic conditions in real-time, and cloud data helps hospitals speed up the diagnosis of COVID-19 cases. The aim is to equip cities with a "digital brain" and a "central nervous system" that integrates data from all government agencies and businesses. This data can be used to

manage sectors and determine which ones to focus on, as well as to allocate resources where they are most needed (Fei, 2021). Smart city solutions help governments and companies not only save money but to reduce vehicular pollution (Fei, 2021).

Figure 32: China's Main Companies of SMART Cities Industry.



Source: Author based on China Smart Cities Market Outlook Research Report 2019 (AskCI, 2019).

Huawei, China's tech giant founded in Shenzhen in 1987 is the main engine of the city's "stratification" process.in August 2020, they presented the 5G-based smart grid, which transmits real-time data generated by sensors at the city's most important land-based facilities and provides feedback. The grid integrates data processing systems used by businesses across industries and government agencies. This creates a unified network infrastructure that enables the wide interconnection of data processing systems and unified municipal management (Huawei, 2020).

AI-powered applications and data processing systems are able to turn municipal management knowledge into capabilities, give public institutions

broad access to AI-driven business processes, and improve the smart technology experience by creating a smart city based on 5G. Shenzhen gets the greatest development opportunities by strengthening the industrial sector, improving the quality of life, and managing more efficiently. The integration of 5G, cloud technology, computing, AI, and industry applications trigger a chain reaction and provide the industry with smart technologies for a variety of scenarios. The technology contributes to ″cities where the industry is booming, governance is efficient and people live happily″ (Huawei, 2020).

The Huawei platform serves as a ″fertile ground″ from which independent software vendors, system integrators, and cloud ecosystem partners build solutions for different business models and meet complex industry requirements. In addition, Huawei plans to continue using its OpenLab to share new capabilities with partners, collaborate, and grow together, enhancing the customer experience, and drive the digital transformation of the industry (Huawei, 2020).

One of the main projects to implement Shenzhen's ″Smart City″ strategy is ″Shenzhen Intelligent Twin″ , a citywide integrated smart system based on Intelligent Twins architecture, which enables the city to collect and process information, make decisions, to develop and provide a more friendly environment for citizens and businesses (Lin, 2021).

The Shenzhen Intelligent Twin system is based on the Six Directions of Digital Shenzhen initiative, which includes (Lin, 2021):

- An extensive network of sensors and telemetry devices;
- An electronic public service system;
- A one-click decision aid system;
- An integrated management system for public safety and city services;
- An innovative service platform for commercial services;
- An integrated service platform for citizens.

Shenzhen Intelligent Twin is part of the Digital Shenzhen project, based on the use of 5G and AI in urban services. The machines are tasked with performing highly detailed, repetitive, and risky tasks, significantly improving the overall productivity and safety of urban services. These services are represented by eight priority areas (Deloitte, 2020):

8.3.1 Smart Healthcare

- Virtual doctor for COVID-19;
- Intelligent image processing and labeling;
- Diagnosis in seconds;

During the coronavirus outbreak, Shenzhen used AI for early detection, early warning, early diagnosis, early isolation, and early treatment. Experts from Peng Cheng Laboratories and the Shenzhen Centre for Disease Control and Prevention created a virtual doctor for COVID-19 using a medical knowledge matching model. The virtual doctor not only assisted medical staff with inquiries but also provided clinical advice on medical care, diagnosis, and treatment. Shenzhen University General Hospital and Bao'an People's Hospital used AI for many tasks (Wang et al., 2021).

AI was used to identify and mark pneumonia spots on images and create images showing the size and proportions of affected lung areas, including three-dimensional images, and to compare patients' initial diagnosis and re-examination. The visual representation of the results allowed doctors to make quick, qualitative analyses and diagnoses within seconds, greatly improving diagnostic efficiency (Lin, 2021).

8.3.2 Smart Traffic Management

- Waiting times at intersections reduced by 17.7 percent;
- Traffic throughput increased by 10 percent;
- Recognition efficiency from traffic cameras increased by a factor of 10.

There are approximately 3.5 million cars in Shenzhen, which is equivalent to 550 cars per square kilometer. This is the highest vehicle density in China, which has caused many problems for all road users. Shenzhen Traffic Police (STP) applied AI and 5G technologies to monitor traffic compliance, reduce congestion and manage traffic effectively (Guevara & Cheein, 2020).

Working with Huawei Cloud, STP has built a citywide intelligent traffic light control network. The decision on traffic light switching times is now based on artificial intelligence and big data. This has reduced the average waiting time at key intersections by 17.7% and increased throughput by 10%. The system also allows emergency vehicles, such as ambulances, to see only green lights on their way to their destination (Lin, 2021).

AI also helps law enforcement agencies. The decision-making platform can respond to data from automatic vehicle identification checkpoints in seconds, while a secondary AI-based recognition system is used to identify unique vehicle characteristics. This results in a 10x increase in the efficiency of the recognition of traffic infringement images (Deloitte, 2020).

8.3.3 Smart Weather Forecasting

- Faster and more accurate weather observation;
- Increased quality of short-term precipitation forecasting.

Shenzhen Meteorological Bureau (SMB) and Huawei signed a framework cooperation agreement to create an integrated Weather + Cloud Platform + AI + 5G model using cloud computing, artificial intelligence, fifth-generation networks and IoT (Lin, 2021).

The model has helped SMB to launch an intelligent spatial grid-based accurate forecasting service for metropolitan residents and to realize an update of the weather service as a whole. The solution uses advanced technologies such as 5G and peripheral computing to increase the frequency and accuracy of meteorological data collection. The images collected by the cameras are glued together to create a complete picture of clouds in the sky, which can be used for accurate grid-based weather forecasting. Machine vision is used to automatically monitor precipitation. The solution tracks droplets as small as 0.2 mm in diameter and provides faster and more accurate weather observation than non-automated methods (Xinhua, 2019).

Finally, the solution uses AI to predict short-term precipitation. AI algorithms create a recurrent neural network to capture cloud cluster dynamics and then predict future trends in radar echoes based on massive historical data. This solution greatly facilitates non-automated forecasting and seriously improves the quality of short-term precipitation prediction compared to the traditional optical flow method (Xinhua, 2019a).

8.3.4 Smart Water Use

- Centralized water management based on sensors and AI;
- One-click decision-making;
- Smart water quality monitoring.

Huawei, Shenzhen Environment and Ecology Bureau, Guangming Administrative Bureau and Guangming District Water Bureau have teamed

up to create an intelligent platform for integrated water management and control (Lin, 2019).

The solution uses big data, cloud computing, and other ICT. Functions of the platform include data received from multiple sensors, information interconnection, situation forecasting and early warning, disaster prevention, and control, and efficient and science-based decision-making systems.

The system also connects to the district command center for control services and the emergency center, providing a comprehensive view of the entire network, full system visualization, and decision-making. In this way, Shenzhen has implemented a new concept for environmental water management.

The system can collect and aggregate environmental and water supply information from sensors throughout the network. Users can check the overall environmental and water supply situation for the whole area, as well as individual aspects, using a service that visualizes the data in the form of a graph. They can view events and remotely monitor the situation on site using the smart environment and water monitoring and early warning services, and then implement a unified management and resource commissioning service using the emergency response system (Zhu et al., 2019).

8.3.5 Smart Financing

- AI-powered transaction risk management Billions in savings;
- Cloud solutions.

Huawei in 2021 unveiled a brand new Financial Cloud-Network Solution to help financial institutions create a ″stable and high-speed″ bimodal architecture. The goal is to accelerate the adoption of innovative services, provide secure and reliable financial services, and lay the connectivity cornerstone for smart finance (Huawei, 2021).

Innovative services such as internet finance and inclusive finance, defined a new era of smart finance. According to the China Banking Industry Services Report, 2020 the number of contactless transactions exceeded 370 billion, the OTC banking rate reached 90.88 percent and a huge number of financial services such as personal lending has moved online (Huawei, 2021).

Banking services are evolving from ″stable″ to ″stable + flexible″ . Banks need to ensure high reliability and, more importantly, accelerate service of innovation, thereby providing a more convenient experience with differentiated financial services (Huawei, 2021).

To become a financial hub, Shenzhen needs a secure financial environment. China Merchants Bank, founded in Shenzhen in 1987, has for years

used a smart credit card risk control system based on big data and AI. It helped keep credit card default rates low.

China Merchants Bank recently carried out an intelligent upgrade to its credit card risk management system, introducing an AI-powered transaction risk and behavior management solution with the ability to directly intervene in an event. Everyday in milliseconds, it performs a count of more than 100 million data points and has already prevented billions of dollars in card-related risk losses (Lin, 2019).

8.3.6 Smart Police

- One-stop investigation system based on intelligent video surveillance;
- ″Multidimensional″ patrolling: drones, police officers with smart equipment, video broadcasting to the command center.

The use of automation in policing is raising far greater concerns than just effectiveness and infrastructure inadequacies. To find an equilibrium between privacy, human rights, and the huge potential of these controversial technologies, full transparency throughout the transition is important (Halder, 2018).

Funding planning, platform building, data management, and application integration have enabled the Shenzhen Municipal Public Security Bureau (SMPSB), Technology and Information Committee, and Intelligence Committee to integrate more than 100 of its systems into the smart city platform and clean up and add 150 billion rows to the database (Lin, 2021).

The SMPSB achieves its goals of collecting data during police work and applying it, as well as sharing data among all police forces. Face recognition, gesture recognition, number plate recognition, and trajectory analysis with artificial intelligence-based video surveillance, as well as an intelligent video search system, form a unified system to conduct investigations (GT, 2019).

In Bao'an district, China Telecom and the public security unit have implemented a ″smart police station″ test scenario. The solution includes 5G, smart devices for officers, real-time HD video feedback, and intelligent recognition based on artificial intelligence. It enables ″multi-dimensional″ policing, including automated drone patrols, motorbike police patrols, a personal wearable intelligent system (with AR goggles and recording devices), and visualized emergency command. These technologies are helping to continually improve the efficiency of policing and are being used to create a multi-dimensional law enforcement system with a police station equipped with 5G at its core (GT, 2019).

8.3.7 Smart City Services

- Speed of processing citizens' applications;
- Waiting time reduced;
- AI is used to pre-check and fill out forms.

The command and control services center built by the Shenzhen government and Huawei is the operational and command center of the smart city. Using huge amounts of data and a large number of systems, it forms a three-tiered management platform for the block-district-city model. Full visualization of continuously updated information and coordinated operations in a single network makes city management services more accurate, scientifically sound, and "smart". This allows Shenzhen to top China's rankings for online public services (Lin, 2021).

In Shenzhen's Longgang district, the government integrated service systems across 89 departments. The city's Intelligent Operations Center (IOC) has five units: data center, operations center, monitoring center, distribution center, and command center. In 2019 the total amount of information in the Lungang district's big data platform exceeded 3.7 billion lines and amounted to 2.7TB. This served as a solid foundation for the government's data acceptance system. AI-powered intelligent customer service, including pre-screening and form filling, has increased application processing speed by 29 percent and pre-registrations by 22 percent, which has reduced user waiting times by 50 percent (Pei, 2019).

8.3.8 Smart Airport

- Risk prediction and early warning;
- Fewer delays and more punctual flights;
- Intelligent counter distribution system.

To switch from paper boarding passes to a facial recognition system, Shenzhen Airport planned and implemented around 100 intelligent projects. The new system has reduced delays and improved flight punctuality (Xu, 2019).

The intelligent large-scale operation and control system, based on the Airport Cooperative Decision Making System (A-CDM), and the new Intelligent Operations Center (IOC), has realized global situational awareness,

forecasting and early warning, bringing a new level of coordinated response. As a result, travel times have been significantly reduced.

Shenzhen Airport has also launched a highly intelligent system that uses IoT and intelligent video analytics to collect data on critical phases of flight assurance on the ground with 95 percent accuracy. By monitoring the entire flight assurance process, abnormal conditions that pose risks to the flight can be quickly detected (Lin, 2021).

Shenzhen Airport is the first airport in China to incorporate AI algorithms into its intelligent check-in counter distribution system. The process is automated, and the airport performs distribution for more than 1,000 daily flights in a minute, whereas before it took four hours. The system can also be updated every 10 minutes. The new solution has made it possible to increase the number of contacts at the counter and reduce the time it takes to serve passengers on the bridge at the airport (Xu, 2019).

Shenzhen Intelligent Twin thus brings the city into the world of AI, fostering the coordinated development of digital government, digital society, and digital economy, ensuring the sustainable development of the smart city. The growth of the integrated application of ICT contributes to the wider adoption of ICT in the local industry. With data circulating in the citywide system as well as shared computing resources with AI, Shenzhen Intelligent Twin provides enterprises and industries with an intelligent platform for innovative applications (Pei, 2019).

The development of digital industries and drive the intelligent upgrading of traditional industries.

Shenzhen Intelligent Twin helps the frontier device and computing ecosystem, receptor ecosystem, and ecosystem realizing interactivity to flourish. By promoting digital industrialization and industrial digitalization, Shenzhen Intelligent Twin is an example of the implementation of new infrastructure that contribute to the qualitative development of the digital economy (Lin, 2021).

However, the application of smart digital technology also carries many threats, and it is necessary to review the introduction of AI in all areas of city life (Khalifa, 2019):

- Digital inequality:
  - Deprivation of access to information and services;
  - Inability to express oneself through ICTs;
  - Information elitism.
- Risk of discrimination and exclusion of certain categories of citizens from the consumption of public goods through the use of smart technologies;

- Limitations on human rights and freedoms in the use of digital identity;
- Threat of one-time disconnection from all public services in case of failures;
- Psychological discomfort of a smart city;
- Problem of dilettantism in public participation in city management;
- ″Information rubbish″ The volume of data transmitted over networks is doubling every two years;
- ″The Internet of Vulnerabilities″ :
  - Hacking risks in AI systems of smart cities;
  - ″Hole in the Toaster″ vulnerabilities in the software of smart home appliances lead to failure of service due to virus attacks;
  - hacking risks in personal (especially medical) smart appliances.
- E-waste risk of increased waste due to rapid electronics obsolescence and disposal;
- Risk of the development of virtual crime;
  - increased political, social, and economic costs of cyber-attacks and data leaks.
- Breach of privacy in the use of urban monitoring systems:
  - personal data may be exposed by indirect methods (collecting dirt from media and social media analysis);
  - use of personal data for criminal purposes;
  - failures in copyright protection.
- The shift of shadow economy to the Internet (through anonymous networks like TOR);
- Cryptocurrency makes commodity-money exchange anonymous (ordering murders, purchase of drugs and weapons, prostitution).

However, despite the threats associated with the implementation of the smart digital city approach, in 2019 the idea was being actively developed not only in China, the USA, and Singapore, which is a recognized global leader in smart city technology development, but in at least 153 cities of 30

other countries, including the EU countries, the UK, Japan, South Korea, Russia, and India (Berger, 2019).

Sustainability and greening, social participation in governance, efficient use of data, and the desire to improve services and quality of life make the concept of smart cities a core strategy for the urban world of the future.

8.4 The Ecological Infrastructure Development

The Ecological Infrastructure (EI) is a key component in ensuring the sustainable development of the city. Indicators of greenery, provision of green spaces, and condition, and sustainability of these spaces to the urban environment are included in the group of indicators of sustainable development of urban areas. The basis of EI is greenery, which forms an environmentally safe, aesthetically attractive, and comfortable environment for living (Zhang et al., 2020a).

An ecological network, or "green corridor network", is part of the infrastructure of green cities, a collection of undeveloped and uncovered urban areas with vegetation. In terms of spatial structure, an urban ecological network system consists of green corridors and ecological plots. These corridors make the spatial structure of urban ecosystems more coherent. An ecological corridor can prevent soil erosion, improve carbon storage and contribute to biodiversity and ecosystem stability (Tang et al., 2020).

An ecological network in a city is necessary to maintain a favorable ecological condition of the urban environment, which in turn is important for the physical and mental health of city dwellers. An ecological network serve to: (Tang et al., 2020):

- Mitigate the effects of global climate change;
- Create recreational opportunities for city dwellers;
- Create a cultural identity for the city and its neighborhoods;
- Reduce the city's "heat island";
- Regulate rainfall-runoff;
- Regulate wind speed;
- Clear the air of dust;
- Absorb carbon dioxide and releasing oxygen;
- Maintain the biodiversity of the city's animals and plants.

Kongjian Yu (2020) and his research team are the authors of an innovative eco-project called ″Sponge Cities″ . The ″Sponge City″ technology, which is being actively developed as one of the pillars of ″green urbanism ″, is part of the climate adaptation strategy. The basic idea of the concept is that a city should ″sponge ″and safely absorb ″excess ″rainwater and store it for future use. ″Sponge cities ″apply the same drainage system as the natural jungle environment, even without considering the devastating climate problems, cities develop ″sponge″ technologies for efficient use of the valuable rainwater resource.

Shenzhen's adoption of the ″sponge city″ concept was under the umbrella of Smart City innovation and was also driven by the fact that the effects of the unbalanced water cycle. Heavy rains often overload the local wastewater treatment plant, sending nutrient-rich wastewater directly into Shenzhen Bay and the Pearl River Delta, causing large algal blooms. Computer models and AI predict that with climate change, the total annual rainfall will be comparable to current levels, but the precipitation will be much ″brighter″ : extreme events such as short-term, high-intensity downpours will become more common (Jenkins, 2020).

The implementation of the ″Sponge City″ includes a set of basic measures (Lu et al., 2018):

- Urban water areas – lakes, ponds, wetlands, canals, and streams;
- ″Green roofs″ of houses, for water retention and accumulation;
- Urban green areas – parks and squares with living vegetation;
- Permeable pavements for roads and pedestrian areas;
- Drainage systems and rainwater drains.

Paving and concrete in modern cities not only contribute to flooding during heavy rains but also increase the risk of fires during the dry season. Rapid economic growth and urban expansion have led to the disappearance of natural water reservoirs such as ponds, lakes, marshes, and streams. As a result, big cities are flooded when it rains heavily, and when there are large downpours, the entire infrastructure collapses. Increasing green space and the accumulation of rainwater in urban water reservoirs significantly reduce the risks associated with these two problems (Yu, 2020).

China has become the first country in the world to launch sponge drainage technology as part of its smart cities and green urbanism strategy. In 2015, thirty pilot cities were selected to implement the innovation, which included Shenzhen and Guangzhou. Annual public investments in sponge cities range

from $60–90 million. Over three years (from 2015–2018), the government invested over $12 billion in sponge projects in 30 cities. The government funds only 15–20 percent of costs, the rest coming from local budgets and private firms. By 2030, it is planned that 80 percent of urban areas in the PRC will absorb and reuse at least 70 percent of the rainwater (Lu et al., 2018).

In December 2020, Changsha City in Hubei province held the country's first rainwater rights deal, meaning that rainwater resources from the sponge city technology can also have commercial value in addition to environmental protection. The rainwater will be used to irrigate green spaces and water the streets (Walsh & Zhou, 2020).

More than half of the PRC's population now live in urban areas and face climate change – severe flooding, water shortages, and heat waves, pronounced in densely built-up areas where concrete and asphalt retain high temperatures. Trees and other plants absorb water and then release it through evaporation, which creates the necessary cooling effect. (Zweynert, 2017).

It is not possible or financially feasible to completely rebuild the whole city centers of major metropolitan areas to "Sponge City" standards. But some elements of the strategy are applicable in most cities – green roofs and water-permeable paving are being actively implemented as part of the Sponge City Initiative. In areas outside the city center, where every meter of the surface has not yet been concreted, urban green spaces and bodies of water are being actively developed (Yu, 2020).

Another aspect of EI is recycling and waste management. Industrialization led to an increase both in the total amount of municipal solid waste (MSW) and in the ratio of inorganic components such as plastics. Plastics could not be disposed of on agricultural land as organic fertilizer, leading to a search for alternative ways of recycling (Bondes, 2019). By the early 1990s, most urban wastes were dumped in landfills on the outskirts of cities without any further treatment, occupying increasingly large areas, resulting in significant soil, air, and water pollution and frequent fires due to landfill gas explosions (Bondes, 2019).

According to Chinese law, solid waste is divided into three types: industrial solid waste, municipal solid waste (MSW), and hazardous waste. Of all these types, domestic waste has the largest share and the most complex composition (Lee et al., 2020).

Solid waste refers to any solid material intentionally discarded for disposal. Most solid waste, such as secondary raw materials, has value and must be recovered from the waste stream. Between 1980 and 2000, the amount of waste increased between 3 and 10 percent per year, and less than 2 percent

of rubbish was treated before disposal. By 2000 the proportion of adequately treated municipal waste had reached only 59 percent – 90 percent of it had been dumped in landfill sites (Lee et al., 2020).

Moreover, as many landfills were not well-managed, they continued to produce significant pollution. In addition to the pollution problems, municipal waste, which continued to grow at a rate of 8 to 10 percent a year, soon began to face a shortage of space as well. In 2004, China surpassed the United States as the largest producer of MSW, producing 190 million tons of municipal solid waste – almost a quarter of the world's recorded waste that year (Bondes, 2019).

In 2001 the State Environmental Protection Agency (SEPA) commissioned a team of researchers who conducted a comprehensive study of the situation and problems in the waste management system. The research team proposed two main strategies to tackle China's waste problem (Bondes, 2019): 1) Promote waste segregation and recycling to reduce the amount of waste requiring treatment and disposal; 2) Promote solid waste incineration at high temperatures.

Although the first incinerator was opened in 1988 in Shenzhen, there were no government initiatives for recycling or systematic separation of MSW in the late 2000s. For the most part, waste sorting in China was, and still is, carried out by a large informal sector of private waste pickers who make a living collecting and selling materials of value – such as paper, metals, and plastics The World Bank estimated that about 2.5 million people in China earned a living in the informal waste management sector in 2005, while only 1.3 million were employed in the formal urban waste management sector (Lee et al., 2020). Since 2010, individual municipalities have intensified their efforts to increase waste sorting and recycling. Urban segregated waste collection and recycling was introduced in the 12th Five Year Plan (2011–2015) (Xinhua, 2011).

National and municipal governments began to promote waste incineration on a massive scale. Since the early 2000s, several national-level government agencies began to develop policies to encourage investment in the municipal solid waste incineration sector in China. Thanks to these policies, companies investing in and operating solid waste incinerators in China have been eligible for various tax rebates and subsidies, as well as priority loans from commercial banks (Bondes, 2019).

In addition, the electricity produced by waste-to-energy plants has been listed as a renewable energy source. This entitles waste-to-energy (WtE) plant operators to significant tax reductions and preferential credits (Lee et al., 2020).

In China, most waste incineration plants are built on the build-operate-

transfer model. Based on a joint investment between the responsible municipality and a company selected through a public tender. Plants are designed, built, and operated by the company during a 30-year licensing period. At the end of this period, the plant is returned to the responsible municipality. The cost of building an incineration plant generating electricity usually pays for itself within 8–12 years, so investor companies can profit from the plant for up to 22 years. The waste incineration has high profit margins and low operating costs, together with large-scale government investment in the technology. This sector is attractive to Chinese and foreign contractors (Bondes, 2019).

By the end of the 12th Five-Year Plan in 2016, the number of incinerators in operation had increased to 250 and the national incineration rate had reached 30 percent, with the target rate reaching 48 percent in the well-developed eastern regions (Lee et al., 2020).

However, not all of the incinerators have been built in compliance with regulations, and the concept of incineration has been criticized by environmentalists as much as traditional landfills and landfills for the presence of harmful emissions into the atmosphere.

The next round of environmental sustainability campaigning on waste started in 2017, when China refused to import recyclables. From 1992 to 2017, the PRC was the largest importer of reusable trash, reportedly importing up to 45 percent of the world's plastic waste (Brooks et al., 2018).

China produced consumer goods for the developed world, which were shipped to customers all over the world on container ships. In the opposite direction, the container ships were loaded with sorted waste such as paper, plastic, and aluminum that was destined to be recycled. The PRC's decision to suspend accepting imported recyclables is also linked to measures to build an ″Ecological Civilization″ , part of which is an initiative to effectively sort and recycle its waste.

In 2017, the central government developed waste sorting systems and standards to be implemented in 46 Chinese cities, to achieve 35 percent recycling of all ″ useful″ waste in these cities by 2020. Specific policies are determined by local authorities, but not everywhere has the waste sorting initiative gone beyond the design of separate collection points for different types of waste. However, the public often lacks basic knowledge of waste sorting, as well as there is not a compulsory initiative from municipal authorities, to get waste sorting off the ground (Wang & Jiang, 2020).

Shanghai became the first city to make waste sorting a compulsory practice and its experience is gradually being transferred to other cities. Since July 2019, the 23 million-population city has implemented separate waste collection. To ensure effective monitoring of the implementation of the inno-

vation, consolidated waste collection sites have been set up, where municipal employees and volunteers work to help city residents properly allocate waste to individual bins. The rubbish bins next to the entrances of residential buildings have disappeared. Rubbish may only be thrown away in these designated areas and at certain times in the mornings and evenings. The waste must be sorted into four main categories: liquid waste (organic waste that decays), solid waste (inorganic waste), recyclable waste, and hazardous waste (Hu, 2019b):

Guangdong province has introduced waste sorting technology since the winter 2020, spending 2.14 million yuan to implement the technology, which is about 2 percent of the city's total services budget. Some of Shenzhen's innovative rubbish bins are connected to the 5G network, equipped with video cameras that read faces and will not open the lid if rubbish is not ″sorted″ correctly (Huang, 2019a).

At the same time, ″zero waste″ campaigns are being rolled out across the country, as the coronavirus epidemic increased demand for takeaway food and correspondingly the amount of single-use plastic packaging as a proportion of waste. At the end of 2021, businesses that use biodegradable packaging receive a subsidy from the government, with Shanghai and Sanya the first cities to completely phase out non-biodegradable plastics (Lee et al., 2020).

The formal inclusion of waste sorting and recycling in MSW management would increase recycling rates by facilitating waste management. The ″zero-waste″ or refuse reduction by the consumer is another waste management strategy often raised in the context of the ″three Rs″ of sustainable eco-management (reduce, reuse, recycle). This includes the introduction of a waste volume dependent household waste fee system to increase the incentive for households to reduce household waste, as well as regulations for companies that encourage the reduction of consumer waste, such as packaging (Lee et al., 2020).

8.5 Shenzhen on the Path to Green Urbanism

The analysis of China's environmental policy aimed at building an ″Ecological Civilisation″ developing according to the principles of Green Urbanism led to some conclusions. First, China is currently still in a state of profound ecological crisis. This is evidenced by the EPI index, developed by the UN to evaluate the ecological efficiency of states. It is possible to draw a conclusion on the condition of human health and environmental protection in the state based on the results of the calculation of this index value. The 2020 EPI ranks China 120th out of 180 countries. (Wendling et al., 2020).

China has consciousness and does not deny the environmental problems

that threaten its continued prosperous development: from desertification and soil erosion, which reduce the size of its cultivated area, to water and air pollution, which increase the mortality rate.

Second, the ecological development of China's territories is extremely uneven, and the government has taken measures to balance the situation to solve ecological problems through the implementation of environmental policy programs, economy, and building of the "Ecological Civilization". One such system is the showcase cities scheme, which should serve as an engine of green technology in their development, set an example for other cities, and stimulate healthy competition to achieve global, national, and regional objectives and targets.

Third, The PRC and Shenzhen governments are focusing on achieving ecological balance and "Green Urbanism" with the help of high-tech giants companies – Huawei, Tencent, Alibaba, and ZTE, which provide the cities with innovative technologies using AI to optimize urban infrastructure and management tasks.

Shenzhen, plays the role of a motor for SMART city innovations and Green Urbanism. The city also faces environmental challenges and a lack of resources to live on. The problem of scarcity of water, land, energy, and natural resources is compounded with the rapid growth of the economy and increasing profits, accompanied by demands for scarce resources. The city government is proposing different methods to meet these challenges (Baldinger, 2019).

Shenzhen's core industry is high-tech innovation, which enables emerging technologies to be applied in the city itself. For example, Shenzhen was the first city in China to make all its buses electric, these buses are assembled at the local BYD company. In addition, most of the city's taxis have also switched to PEVs, reducing not only emissions but also fares. The solar-powered lighting systems have been installed throughout the city. Also, since 2016–2020, three waste incineration power plants were built in Shenzhen that meet European Union standards for emissions and recycle 10,300 tons of waste daily. Shenzhen actively participates in the government's zero waste and waste sorting programs. And is going to host the world's biggest plant covering an area of 112,645 sq.m, capable of incinerating one-third of the city's existing waste and generating energy. It is estimated that it could produce around 550 million kWh per year. The roof of the main building would provide part of the electricity thanks to the installation of 44,000 sq.m. of solar panels. The most advanced technological systems have been installed, and this micro-city designed for waste management is used as an information point for Shenzhen's citizens (Ramos, 2021).

Shenzhen is also the city with the most well-maintained parks and green

infrastructure networks. Thanks to the "Shenzhen – City of 1000 Parks" project, ecological space, which makes up about 50 percent of the city area, has been protected from development (Dong, 2019).

Shenzhen is also the only city in the country to ban the combustion of highly polluting fuels, and the first city in China to analyze PM2.5 concentrations in the environment, implement pollution control for ocean-going vessels, and have the highest proportion of clean energy capacity installed. Thanks to Shenzhen's "standards system" for the environment, the number of days with haze has been reduced from 187 days in 2004 to 20 days in 2018, earning the city a reputation as a "blue-sky" city (Dong, 2019).

According to Shenzhen's urbanization plan, environmental protection is an integral part of the development of the urban space. The three main objectives of the city's development are (Dong, 2019):

- Achieving harmonious development of economy, society, and environment;
- High level of economic development, harmonious social structure, flourishing culture, and sustainable ecological system;
- Efficient and moderate use of land and water resources together with environmental protection.

Shenzhen has also been at the forefront of greening the construction industry. It has taken a leading role in setting green building standards and issuing a regulation on energy efficiency in buildings. In 2006, China issued its first national "Green Building Rating Standard", which proposed the concept of green buildings, which involves saving energy, land, water, and materials, protecting the environment, and reducing pollution. This officially launched a government campaign to evaluate green buildings and encouraged the construction sector to move towards decarbonization (Dong, 2019).

In 2010, Shenzhen took the lead in the country by introducing a mandatory requirement for government-subsidized housing to follow green building standards. In 2012, it released the "Guangming New District Plan (2007–2020)", becoming the first city in the country with a mandatory green building requirement for all district-wide buildings. This was the first systematic practice of the green city concept. Shenzhen now has the largest scale and density of green buildings in China, including green schools and eco-industrial parks (Song et al., 2020).

In Shenzhen the Carbon Coin service platform encourages citizens to adopt green and low-carbon lifestyles and rewards them with Carbon Coins when, for example, a platform user chooses to cycle to work. These CO2

emission reductions are in turn converted into Carbon Coins, which can be exchanged for goods or products in the network of affiliated merchants (Dong, 2019).

Shenzhen has a progressive system of laws, regulations, and standards. About two-thirds of Shenzhen's more than 20 environmental laws and regulations were enacted before they became nationwide, including a system of daily fines, under which a polluting business will be fined daily until the situation is remedied (Dong, 2019). This system was initiated by the Environmental Protection Regulation of the Shenzhen SEZ and then incorporated into national legislation. In addition, all companies with pollution sources are listed so that members of the public can ask the authorities to investigate any alleged environmental violations – this is known as "à la carte" enforcement (Song et al., 2020).

On 1 October 2020, Shenzhen passed an environmental law that allows non-governmental organizations (NGOs) to sue polluters, the first of its kind in China. The ordinance, approved by the Standing Committee of the Shenzhen Municipal People's Congress, the city's highest decision-making body, allows prosecutors, government agencies, and NGOs to sue environmental polluters. According to the Shenzhen government's website, by doing so, Shenzhen is becoming a pioneer in environmental public interest litigation (EPIL) (Huang & Luan, 2020).

To encourage NGOs to fight for environmental protection, a new ordinance reduces the cost of pollution-related litigation, allowing for reduced or deferred litigation costs if NGOs cannot afford them. Shenzhen has also set up a public welfare fund to cover the legal costs of anti-pollution litigation and repair environmental damage. The fund will be financed from compensation from offenders and donations from the community.

Other practices in Shenzhen include the development of China's first local wastewater permit regulations and the implementation of a pollution source classification management system (Huang & Luan, 2020).

Shenzhen also plays a leading role in conducting a comprehensive environmental study and assessment of the state of the land and is the first in China to deploy an urban environmental monitoring network. In addition, more than 22,000 environmental protection volunteers are actively involved in environmental monitoring and education. In 2020, the city had 11 environmental education centers, seven nature schools, and more than 140 environmental protection organizations – the most among Chinese cities (Dong, 2019).

Shenzhen will continue to serve as a model for sustainable green transformation that balances industry with ecology and livability. Serves as a sample of a balanced environmental city. Shenzhen's efforts coupled with a

strategy to build a national innovation system of smart cities based on Green Urbanism, are the key to the successful development of the country. China will continue to pursue an "Ecological Civilisation" development path based on the principles of sustainability and Green Urbanism. The 14th Five-Year Plan (2021–2025) promotes further decarbonization and innovation in local technology, but will not propose extremist measures to combat climate change. Building on today's successes and innovations, China aims to take global leadership in green technologies and sustainable solutions.

9 The Uncertainty Factors in the GBA Development

The uncertainty factor is intrinsic to economics. The mechanism of an economic system is partially unknowable by the state and government itself, as well as by economic science. The indeterminacy of the economy means a variety of possible ways of its evolution. Decisions taken under conditions of uncertainty by the authorities cannot be fully justified and unambiguously rational.

The endogenous cause of the partial lack of cognition of the economic mechanism lies in the contradiction between the extreme complexity of the system, in which there is a changing interaction (both rational and irrational) of many different factors affecting the development of the system, and the limited possibilities for collecting the necessary information, its adequate perception and processing by both the system actors and researchers (Dow, 2015; Arpe, 2012).

Exogenous causes include unpredictable alternations between ″breakthroughs″ and ″pauses″ in the introduction of technologies based on scientific discoveries; social and political upheavals; epidemics, and wars; changing ownership, distribution and exchange institutions; uneven international development, leading to unexpected shifts in terms of trade and financial relations; natural and man-made disasters that worsen the economic environment; and corruption (Arpe, 2012).

According to Frank H. Knight in his work ″Risk, Uncertainty and Profit″ (1921), in a market economy, where uncertainty prevails, it is not the process of production that matters, but deciding what to produce and how to produce it. The entrepreneur, who takes responsibility for the decision, dictates the entire organization of production and is rewarded in the form of profit. The thesis of the unknown economic mechanism was developed in the concept of ″expanded order″ and ″organized complexity″ by Friedrich August von Hayek and in the works of several other economists. The ″rational expectations theory″ of Robert Lucas, which dominated economics during the last quarter of the 20th century, is regarded as a complete negation of market uncertainty. According to this theory, subjects of the market take rational decisions based on their full understanding of its system as a perfect competition mechanism. Only the state can introduce uncertainty through its inconsistent economic policy (Emmett, 2021).

The boundary of uncertainty or certainty in economic practice is in most cases contingent and mobile. Certainty (cognition, predictability) in the economy, is explained by its inertia, as well as the rationality of the subjects,

the amount of practical experience, and scientific knowledge, and can increase during periods of "calm" development. But there are periods of unpredictable deep scientific, technical, socioeconomic, and political transformations when the relative role of uncertainty increases sharply; then the complexity of the economic system acquires new qualities, and previous experience and knowledge prove to be insufficient (Arpe, 2012; Emmett, 2021).

One problem of economic uncertainty is the no clear answer to the question of whether the market economic system, on a self-regulating basis (i.e. without systematic state involvement), is capable of producing more or less sustainable growth, high employment, and improved prosperity.

9.1 Imbalances in the Economic System

Economic imbalance occurs when the interaction between two parts or variables of the economic system is not balanced. That is, they have not reached a point of equilibrium. The economic uncertainty of the Pearl River Delta Region's development included imbalances because of maximizing growth rates during the period of export-oriented production of the mid-1980s and early 00s. The economic imbalances were internal and external. Domestic imbalances include the so-called aggregate demand imbalances: "excessive" savings and investment, on the one hand, but low and even, in some periods, falling private consumption, on the other hand (Timini, 2017; Sznajderska & Kapuściński, 2020).

The economic imbalances of the "Reform and Opening-up" period should be distinguished according to their degree and level of depth (Timini, 2017):

- Imbalances in the structure of demand (surface level);
- Imbalances in income distribution (medium level);
- Imbalances in the production structure (deep level);
- Imbalances in the very essence of the economy's growth model – at least until the crisis of 2008–2009 (basic level).

The external imbalances up to 2017 were primarily due to exchange rate policy, state export promotion, large foreign trade surpluses, and capital account surpluses, and the resulting unprecedented growth of Gold Foreign Exchange Reserves – which at the same time had little effect on the relatively low level of private consumption in China during the 2000s (Timini, 2017).

In 2010, "China Security Journal" published the country's data on the composition of its gold reserves for the first time, showing that 65 percent

of China's reserves were denominated in US dollars and/or US securities, 26 percent in euros, 5 percent in British pounds and 3 percent in Japanese yen (World Bank, 2021).

The aggregate demand imbalances are explained by significant income differentials; an underdeveloped social security system; "Hukou" registration of population; the 1979–2015 "One family, One child" demographic policy; "underdeveloped" financial system; some local traditions, and so on.

The change in China's and the PRDR's national income distribution over the first thirty years (1979–2009) of market reforms – from a high savings rate to a relatively low domestic consumption rate – is directly related to the pattern of rapid growth in the early stages of "Reforms and Opening Up". This cause-and-effect relationship is understandable, from the standpoint of theories of the world economy and the practice of "world catching-up" countries. The high level of savings of the population, associated to a large extent with the underdeveloped social welfare sphere, resulted in an high rate of gross savings, which combined with a national idea of "reviving the country's former greatness" explained in some aspects China's record high – on average about 10 percent per year – economic growth rate during the first reform thirty years (Cristadoro & Marconi, 2011; Ding & Tay, 2016; World Bank, 2021).

During the first 30 years of market reforms, the PRDR's economic growth model was extensive, and based on low resource prices. Above all, it relied on cheap labor, whose supply was "virtually unlimited" and whose costs were low, in large part because of the lack and shortcomings of the social security, health care, and pension costs. On the other hand, returns on capital with low, sometimes even negative interest rates on credit were quite high.

The growth phases of the PRDR's economy in the 1980s and 2000s are (Wang et al., 2016; HKTDC, 2019a):

- The initial "breakthrough" to the market and the admission of private enterprise in the 1980s;
- The market radicalization and institutional development of reform in the 1990s –with a corresponding increase in the labor and savings motivation of the employed;
- Gradual transition from a predominantly labor-intensive to a capital-intensive development path;
- Subsequent increase, especially after accession to WTO (2001), of the total contribution of the extensive factor of investment volume to economic growth –including due to the world's highest levels of household savings and gross capital formation.

In the late 2000s and 10s, the PRC Government undertook a series of measures to balance the national economy (OECD, 2012; Wang et al., 2016; Sznajderska & Kapuściński, 2020):

- Expansion of consumption and a gradual increase in its qualitative level – as the main measure to eliminate imbalances in the economic structure at the household level;
- Encouraging a reduction in the propensity of the population to save and a corresponding gradual reduction in the overall level of investment;
- Supporting a moderate growth in exports with a further increase in high-tech exports;
- Gradually eliminating the imbalance in income distribution (poverty eradication) by raising incomes in rural areas and of the insufficiently solvent population in cities;
- Greater control over the share of net income and taxes in the gross revenue of companies;
- Gradual increases in wages;
- Further optimization of the renminbi's value, including more control over the foreign trade surplus and the volume of foreign reserves.

However, the most important step was to accelerate the transition of China's and the PRD's economy from predominantly extensive growth based on low-cost labor and heavy industrial production to a more intensive, innovative, and environmentally balanced development model based on increasing the aggregate productivity of all factors of production and the transition to a digital "green circular economy" (Chu, 2020; Wang et al., 2020a; Liu & Li, 2021).

Thus, the second stage of reforms is characterized by the strengthening role of intensive factors of economic growth. The PRDR implements a new national model of the sustainable development of economy and society, man and nature, domestic and foreign markets. They follow the innovative model of the quintuple helix, adequate to the gradual completion of the phase of industrialization in the country, as well as transferring the economy to high-tech manufacturing industry, and post-industrial development path, shifting the focus from industry to the service sector as the main driver of the economic development.

By 2020, the PRC government had virtually eliminated poverty and tackled inflation, a major threat to economic growth; the country's budget deficit

became less than 1–1.5 percent; a property market crisis and a regional debt crisis were averted. Nevertheless, experts from the IMF in 2017 pointed to several challenges that the PRC should overcome (IMF, 2017):

- A decline in corporate profitability. The appreciation of the nominal exchange rate of the RMB reduced the competitiveness of Chinese companies. In addition, companies' costs, such as personnel, raw materials, and energy, raised;
- The problem of rising wages. On average, wages increased by 15 percent over the last few years. Recent wage increases were linked to an increase in the minimum wage, which was the government's way of protect workers' rights;
- Underestimating the demographic problem. About half of China's recent GDP growth came from capital increases, meaning companies invest in expanding capacity rather than increasing productivity. But this strategy only works in a labor surplus situation;
- The problem of a shrinking workforce. After 2020, China's workforce will begin to shrink. Companies will have to raise wages sharply. In 2015, the IMF estimated a surplus labor force of 150 million, and by 2020 it will have decreased to 30 million. Between 2020 and 2025, China's surplus labor force will gradually disappear as the country's main competitive advantage;
- The problem of excess investment. Investment plays too large a role in the Chinese economy – it is almost 50 percent of GDP. As a result, there is overcapacity, which falls into an underutilization situation. The capacity utilization rate fell from 80 percent to 60 percent between 2009 and 2017. This could eventually lead to deflation, more company bankruptcies, and financial losses. Under certain unfavorable circumstances, this could be followed by a sharp decline in investment, a fall in GDP, and a fall in employment.

9.2 The US – China Trade Conflict

The United States is one of the GBA region's major trading partners. According to data compiled by the Guangdong Statistical Yearbook, the total imports and volume of exports to the United States from 2010–2019 is about 16.77 percent of the total import and export trade in Guangdong Province (Boylan et al., 2021). Because of the dependence of Guangdong's export

trade on trade with the United States, Sino–U.S. trade conflicts directly affect Guangdong's import and export trade. The pressure on Guangdong's export enterprises is intensifying because of the high tariffs and duties imposed by the U.S. China's anti-system tariff measures have increased the import burden of Guangdong businesses. In 2018, Guangdong's trade with the U.S. was 87.31 billion yuan, and in 2019, Guangdong's trade to the U.S. was 80.5 billion yuan, down 7.2 percent a year. Trade disputes between China and the U.S. had little impact on Hong Kong's direct trade, but Hong Kong's transit trade (indirect trade) suffered greatly.

In the first nine months of 2019, Shenzhen's economic growth rate fell to 6.6 percent, the lowest level since 1979, driven by the impact of trade and technology confrontations with the US that escalated in 2018. In brief, the trade confrontations between China and the USA, as well as Australia, have led to an economic crisis caused by both endogenous and exogenous reasons. The US–China trade confrontation is at odds with the idea of duty-free free trade and is a de facto return to protectionism and preferential trade. An uncertainty factor that has had a direct or indirect impact not only on the GBA but also on the world as a whole.

In March, 2018 US President Donald Trump signed a memorandum on ″Combating Chinese Economic Aggression″ . The memorandum included an increase in import duties on steel (up to 25.0 percent) and aluminum (up to 10.0 percent) from the PRC. In retaliation, in April of the same year, China imposed additional duties on 128 US products: duties on 120 products (such as fruits) reached 15.0 percent and on the remaining 8 (such as pork) 25.0 percent. After almost two years of the escalating trade conflict between the two countries, significant progress was made in the negotiations in December 2019. In particular, US authorities said the first phase of a trade deal with China was ready after 13 rounds of negotiations (Lau, 2019; Zhang et al., 2021b).

The most affected by the trade confrontation between the countries were the Shenzhen-based tech giants Huawei and ZTE. The first claims against Huawei came from the US authorities at the beginning of 2012. At that time, the US House Intelligence Committee warned of alleged national security threats from these companies. The committee's report did not result in any restrictions for them. However, after Trump was elected president, US authorities once again began accusing Huawei of ties with the Chinese government (Steinbock, 2018; Lau, 2019).

In August 2018, US senators said that the company's devices threatened the country's security. The consequence was an updated national defense law that banned Huawei products from being used in government agencies. The company's CFO Meng Wanzhou was detained in Canada in December 2018

on suspicion of violating US trade sanctions on Iran. In January 2019, the US Department of Justice (DOJ) openly accused Huawei of industrial espionage and technology theft. The agency's report alleges money laundering, trade-in trade secrets, and bank fraud (Moosa et al., 2020; Kapustina et al., 2020).

The DOJ report unleashed the US authorities, and in May, the US Department of Commerce blacklisted Huawei. This means a "blockade" of the company: American partners will not be able to cooperate with the Chinese firm. Huawei was then granted a three-month license, but IBM, Google, ARM, Qualcomm, and other US companies refused to work with it.

The restrictions on Huawei are directly related to the escalating trade conflict and technological competition between China and the US. Huawei is considered the largest developer of 4G and 5G networks and is also the second-largest smartphone manufacturer in the world, surpassed only by Samsung (Jaisal, 2020; Zhang, 2021).

Qualcomm, a US company, was actively developing CDMA technology in the 3G era, when it became almost the sole owner of all patents. With the advent of the 4G and then 5G era, the US company no longer holds any patents, and almost all of them are owned by Huawei. Qualcomm is nonetheless a patent holder and one of the world's largest chipmakers. In China, however, the multi-stage chipmaking process is still not fully worked out, so the Chinese firm is not adequately protected (Jaisal, 2020; Zhang, 2021).

Therefore, Huawei was an easy target for sanctions: Like almost any smartphone manufacturer, the company is dependent on third-party suppliers. And for US sanctions, the company is suffering many billions of dollars in losses. But now it is buying chips from Taiwan and hope for a resolution, and its subsidiary brand Honor is launching new smartphones despite all the problems.

Thus, the Sino–U.S. trade conflicts had an impact on import and export trade in Guangdong, Hong Kong, and Macau. Sino–U.S. trade friction affected the cost of exporting labor-intensive products in Guangdong, increased the burden on Guangdong businesses, had consequences in corporate profit margins, reduced the export competitiveness of labor-intensive products. Which in turn affected the foreign trade of Guangdong's high-tech products. The United States "301" investigation was mainly focused on high-tech products, which greatly increased the export value of Guangdong enterprises' high-tech products and increased the pressure on export enterprises. Trade in electronic products manufactured in Guangdong accounts for more than 60 percent of Guangdong's trade with the US that had suffered losses because of Sino–US trade conflicts. The United States imposed tariffs and duties on Chinese goods, thereby increasing their cost. Hong Kong's

re-export trade also suffered (Zhang et al, 2022).

Since China and the United States are each other's major trading partners, and the US and China are Hong Kong's major import and export countries, Hong Kong's re-export trade has also been affected by Sino–U.S. trade conflicts.

It could be interesting if you include a figure with the evolution of trade balance (import-export) of China with the world and with the US (since 2010 to 2022). The data are contradictory with the supposed results of the conflict that began in 2018 with the Trump administration.

9.3 The Mainland–Hong Kong Ideological Debate

Another impact factor on the future of the GBA Project is the uncertainty in Mainland–Hong Kong's social and political relations. This is reflected in the protest movement in Hong Kong in response to the PRC's attempts to bring norms to a common denominator with mainland China. The close economic and social integration of recent decades, since Hong Kong's return to PRC sovereignty in 1997, and the struggle between two parties with fundamentally different understandings of law and governance, have underpinned and transcended the disputes of the moment.

The strongest debate and protests took place in Hong Kong in June 2019, centered on proposed legislation that would authorize the Hong Kong government to hand over to mainland Chinese authorities those whom the latter has identified as criminal suspects. Formally, the proposed legislation was called the Fugitive Offenders and Mutual Legal Assistance (Amendment) Bill 2019. It would have allowed transfers to mainland China and many other jurisdictions. The head of the Hong Kong government, Carrie Lam, introduced the bill as necessary to allow extradition to Taiwan in a highly publicized case in which one member of a young Hong Kong couple killed the other-over an alleged affair-while traveling to Taiwan. The bill promised to limit extradition to a specific list of crimes, not including political offenses or several commercial crimes and provided for judicial review of government decisions to Mainland's extradition requests (DeLisle, 2019).

For opponents of the bill, such features and assurances from the Hong Kong government were insufficient. In their view, the legislation was yet another step that undermined the fundamental commitments set out in the 1984 Sino–British Joint Declaration of Return to China and in the Basic Law, which serves as the mini-constitution of the Hong Kong Special Administrative Region (SAR): Hong Kong will enjoy autonomy in government and continuity of previous orders, including the rule of law. The extradition bill emerged against the background of the Hong Kong 2014 Occupy Central

–or "Umbrella Movement", as a previous popular protest in this context. The proposed law echoed the arguments of critics that the extradition bill violated another key promise – Hong Kong's progress toward democratic governance (DeLisle, 2019; Lee et al, 2019).

Despite close and mutually beneficial economic cooperation, the social and cultural unification of the two systems is still difficult. In the Hong Kong SAR, conflicting identities are on the rise. The people of Hong Kong want to retain their autonomy and civil rights as enshrined in the Joint Declaration and the Basic Law. Protest movements are particularly strong among the younger generation. The victory of opponents to integration with the Mainland in the November 2019 legislative council elections marked the beginning of political opposition to reunification with the PRC and cast doubt on the foreseeable feasibility of the "One State, Two Systems" concept and its extension to Taiwan. All this together poses a threat to the realization of the "Chinese dream of a great renaissance"and the "Harmonious Civilization of the Future" based on the idea of China getting world-building functions in the international arena (Chow et al., 2020; Lee et al, 2019).

The relationship between the Hong Kong SAR and the PRC's central government is based on a formula that assumes the coexistence of two social, political and economic systems in a single state. At the beginning of the "Reform and Opening-up", the main difficulty in implementing this principle was seen by the Chinese leadership as the ideological contradictions between the socialist and capitalist models. Over the years, both systems came with a close and beneficial economic interaction. A decisive role in reducing the differences between them was played by the evolution of socialism with Chinese specificity from the plan to the market. Thus, fears of ideological incompatibility did not materialize (Chow et al., 2020; Purbrick, 2019).

However, the main driving force of social integration (the sense of common nationality and patriotism designed to unite a people with a common language, culture, history, and civilizational identity) did not work as planned in the case of Hong Kong. Behind the concept of "ideological contradictions" there was something more than a difference of class interests. The polarization of society in Hong Kong until 2020 was increasing due to the decline of patriotic feelings among the younger generation of Hongkongers. Many of them openly declare their unwillingness to be associated with the "mainland Chinese" (Chow et al., 2020; Summers, 2019; Ngai, 2020).

There are various hypotheses of further developments of Hong Kong–Mainland relations. The COVID-19 pandemic (since 2020) was a common threat that cooled the tensions and hindered the integration processes between China and its SARs. However, even before the pandemic, the Chinese

government staked on the commonwealth and integration of Hong Kong with neighboring Shenzhen, which has become the most developed mainland city in the GBA and is increasingly integrated with Hong Kong in terms of transport, economics, and culture. For example, there is a high-speed railroad between the two megacities (travel time is only 14 minutes) and a cross-trading mechanism for stock exchanges.

Against the backdrop of a slowing global economy, Hong Kong's prosperity depends directly on deep integration with the mainland. Hong Kong is "fueled" by China's rapidly developing economy and remains China's "window" to the outside world, the main mediator in trade and economic relations with many countries. Hong Kong is still mainland China's largest investor and its most important financial center with access to international investors.

According to Chinese President Xi Jinping, dragging Hong Kong society into excessive politicization can harm the city's economic development. At the same time, the attempts to infringe on the territory's autonomy and the increased control over it, have not had good results. Hong Kong's prosperity is based on its openness and legal freedoms of the British type, and any changes in the direction of their restrictions may scare away foreign investors. Some of them have already moved their offices to "less problematic"Singapore (Sin & Kwok, 2019; Hiciano-Gomez, 2020).

9.4 The Covid-2019 Pandemic

The 2019 COVID Pandemic has become another factor of uncertainty directly affecting the integration processes within the GBA, as well as global integration processes and humanitarian contacts between cities and countries. The pandemic has challenged humanity as a whole, which has not yet developed a unified strategy for the application of quarantine safety measures.

The PRC, unlike other countries, had the experience with SARS caused by coronaviruses. The first SARS virus in the 21st century appeared in China in November 2002 and reached its peak in March-April 2003. The official announcement of limited cases of the new disease was made by the Guangdong Provincial Health Department on 11 February 2003. The next day, Xinhua News Agency stated that the disease was "brought under control" and no new cases were reported. Although information about the new disease spread rapidly via the internet and the media, there was no official statement from the authorities, nor any reaction from the central government. In mid-March 2003, despite the news of the epidemic in Beijing, the first session of the 10th National People's Congress (NPC) began as scheduled (Lai, 2003;

Huang, 2004).

At that time, the statements and actions of various PRC officials were inconsistent and contradictory. In April 2003, PRC Health Minister Zhang Wenkang said that the disease had been stopped and urged all travelers to stick to their previous plans and come to China despite evidence to the contrary. Despite the WHO's March 27 recommendation to postpone all non-urgent travel due to the new SARS virus epidemic, the statement was made.

It was not until 21 April that PRC officials publicly apologized for "leadership failure" and began reporting cases, faced with overwhelming evidence of a new epidemic. At the same time, Zhang Wenkang and Beijing Mayor Meng Xuenong were fired for insufficient efforts to combat SARS. It turned out that the number of cases that had been published before were underreported: for example, 339 confirmed cases of infection and 402 on suspicion in Beijing, whereas ten days earlier Zhang Wenkang only reported 22 patients detected. Chinese Deputy Health Minister Gao Qiang noted that the country's Ministry of Health was not prepared to deal with the unknown disease, and "accurate figures [on the number of cases] were not reported to higher authorities on time" (Huang, 2004; Cherry & Krogstad, 2004; Christensen & Painter, 2004).

Thus, the response to the SARS epidemic in 2002–2003 and to COVID-19 in 2020 by the Chinese leadership showed that they learnt from past mistakes and reacted more quickly to the emergence of a new virus. The first time the response took about six months, but in 2020 took less than two months, although this was not enough to prevent a pandemic, given the holiday season and the Chinese New Year when population movements inside and outside the country are very intense (Yu & Li, 2020; Yu et al., 2021).

However, the PRC managed to bring the spread of COVID-2019 under control and has maintained a "zero COVID" strategy based on strict quarantine measures till 2023. This was possible by the reforms introduced between 2009 and 2020, which greatly reshaped and optimized China's entire health system that was affected by a previous wave of corporatization in industry and agriculture that undermined the public health system for insurance and medical care (Xu et al., 2020; Yu et al., 2021).

The national government, realizing the existing problems and considering the mistakes of the authorities in responding to SARS, initiated a socially oriented program of reform of the entire health system, which was launched in April 2009, to ensure equal access to basic health care for all citizens by 2020. The market model of the previous two decades of reform and openness policies created the conditions for the development of for-profit health care, in which often only the ability to pay provided access to health services. In

contrast, the 2009 reform emphasized equal and universal access to health facilities (Alcorn & Bao, 2011; Sun et al., 2021).

By now, the zero-covid strategy used in Guangdong province and throughout China has been to prevent mass infections by closing borders, digitally controlling people's traffic and migration, and continuously and massively screening the population, through widespread temperature measurements in public places and regular and mass PCR tests, the results of which are presented as a pass to public places and events. The wearing of masks and the treatment of surfaces with sanitizers is also controlled.

When an infected person is identified, their location is closed for quarantine, safeguards are posted. Data about the sick person and his movements is published in the official news. Deep disinfection of public places is carried out. Patients with a suspected virus and fever are screened out and taken to designated camps and hospitals for treatment.

Since March 2020, there has been a policy restricting the flow of tourists and communication with other countries. The Government classifies areas across the country according to the level of disease activity, with the following risk categories (Chinazzi et al., 2020; Buckley & Marcus, 2021):

- Low risk: areas with no new confirmed COVID-19 cases and no confirmed cases for 14 consecutive days;
- Medium risk: areas where COVID-19 activity does not exceed 50 cases within 14 days, or more than 50 cases but not within 14 days; no clusters have been reported within two weeks;
- High risk: locations where the number of new confirmed COVID-19 cases exceeds 50 and an increase in cases has been reported within 14 days.

In May–June 2021, several localities in Guangzhou, Foshan, Shenzhen, and Dongguan, Guangdong Province, as well as one locality in Luan, Anhui Province, were declared as medium-risk areas. Two localities in Guangzhou were also declared high-risk zones. Those who live in or have recently visited high and medium-risk zones face restrictions on travel, movement, and public events. Authorities often lock down certain communities in these areas, requiring residents to stay in their homes or provide a negative COVID-19 test result before leaving the affected area. Local governments conduct several rounds of mass testing in medium or high-risk areas. Roadblocks and checkpoints were also being set up on roads leading to high and medium-risk cities and counties in response to detected outbreaks. In areas where COVID-19 activity was observed, long-distance transportation services were restricted,

and testing requirements were in place for persons wishing to travel (Zanin et al., 2020; Zhang et al., 2021b).

During outbreaks in high and medium-risk areas, municipal authorities require people to have all intercity commuters tested for COVID-19 before any intercity travel, and there is also a 48-hour rule during which the test results are valid. Authorities conduct medical screenings at airports, train stations, and subway stations, which increases travel times. Public transport operators in most major cities require passengers to give information about their health code (green code) before boarding public transport. Citizen's movements are monitored and if an outbreak is detected in the region from which the border came, testing is done, sometimes in the entire neighborhood where the suspect lives. Based on the test results, restrictions are lifted or imposed, and mandatory vaccinations are administered (Zanin et al., 2020; Zhang et al., 2021b).

The government has banned most foreign nationals from entering China till the end of Covid zero policy in 2023. Countries were also graded according to their prevalence of infections and are divided into green, yellow, and red zones. Foreigners from most green countries with valid residency permits to work, visit family, and deal with personal matters could enter the country. Some immediate family members of foreign green-country workers may also be permitted to enter the country for emergency humanitarian purposes. Specially designated foreign workers with letters of invitation from provincial or municipal officials could also enter the country. Foreign nationals traveling to mainland China for work, business, or humanitarian reasons may waive the invitation letter requirement before applying for a new visa if they are fully vaccinated with the Chinese-made COVID-19 vaccine. However, most foreign nationals arriving from Bangladesh, Belgium, France, India, Italy, the Philippines, Russia, and the United Kingdom are prohibited from entering the country, regardless of residency status, if they have not received the Chinese-made COVID-19 vaccine. Diplomatic personnel and C-visa holders, usually air and sea crew members, are exempt from the entry ban, regardless of country of origin. In 2021, authorities also suspended air travel to the U.K. until further notice (Chinazzi et al., 2020; Buckley & Marcus, 2021).

Business trips from Singapore and South Korea were officially allowed under the fast-track scheme. Travel was possible between Singapore and the provinces of Guangdong, Jiangsu, and Zhejiang, as well as Chongqing, Shanghai, and Tianjin. There was also expedited treatment for business travelers from South Korea to ten Chinese cities, including Shanghai and the provinces of Liaoning, Shandong, Jiangsu, and Anhui. Companies or government agencies could apply for special passes for inbound visitors who must pass a negative COVID-19 test within 48 hours of departure from Sin-

gapore or within 72 hours of departure from South Korea and obtain a visa. This category of passengers were tested for COVID-19 upon arrival in China and self-isolated in designated areas (usually hotels) until the results were received. Singaporean travelers must also adhere to a pre-planned itinerary, refrain from using public transportation – except private hired vehicles, for the first 14 days, and load and use a health code while in the country. Arriving passengers who test positive for COVID-19 are treated at their own expense (Chinazzi et al., 2020; Buckley & Marcus, 2021).

China was continuously working to improve its response to COVID, reduce its impact on the population and economy, and make it more and more appropriate to the local conditions and current variants of the virus. Nationwide recommendations were constantly updated (Lai, 2022).

With the passage of time, quarantine restrictions for those arriving from abroad, as well as quarantine restrictions for outbreaks within the country, were considerably reduced. Mass PCR testing of at-risk groups and sometimes the entire population of regions at risk were among the main anti-epidemic tools. Both the testing process and the laboratory work were significantly streamlined.

There were several types of quarantine in case of outbreaks. At the relatively low risk of infection, a 72-hour snap quarantine and two rounds of PCR testing deem sufficient. At higher risk, a 4 or 5-day quarantine with at least three rounds of PCR testing is undertaken. For close contacts, and the public arriving from abroad quarantine at this time is set for 7 days. In all these cases, quarantine was lifted exclusively on confirmation of a negative test result on the last day of quarantine. If carriers of the virus continue to be detected in the quarantine centers or districts, the quarantine shall be extended.

In today's Chinese metropolises, the population is extremely dense and mobile at the same time. This contributes to the fact that COVID outbreaks very quickly affect large numbers of people. The most effective tactic to deal with such outbreaks, therefore, is to test the people at risk as quickly as possible and then to designate "high" and "medium" risk areas in the city where quarantine is imposed. Routine PCR testing of the city's population then continues for a while but virtually all other restrictions are lifted except in quarantine areas. This approach is very effective when the quarantine areas constitute only a small part of the city. But if mass testing is not organized efficiently, just 10–15 days is enough to turn the whole city into a medium or high-risk region, making it extremely difficult to carry out further actions, including the supply of food for the public.

Priority is given to measures with minimal impact on the population, e.g. multi-spot PCR testing of wastewater (Lai, 2022; Luo, 2022).

With the existence of uncertainty factors, it is difficult to predict how the development of the GBA Project, as well as China's foreign and domestic policies in general, will take place. But we can already conclude the gradual winding down of the policy of opening up to care for national interests and security.

10 Conclusion

To analyze the modern Chinese Regional Innovation Systems (RIS), Shenzhen as the Bay city center, and the GBA as a complex phenomenon need to understand that although they are unique examples of systematic approaches to the organization of space, economy, and society, its creation has accumulated the national and global experience and achievements of scientific thought, which itself illustrates the technological progress, integration potential and indicates a vector of development.

The present stage of development faces challenges that can be countered only by integrating and generalizing global scientific thought and ideas of humanism to choose the optimal and sustainable vector of development. The study of the experience of organization and formation of the GBA RIS makes it necessary to understand the general paradigm of the movement of integration processes. Both from the society and technical spectrum of scientific disciplines and approaches.

The development of ideas, forms, and conglomerations became possible in the framework of the complex approach and systematic implementation that put into practice innovative ideas about the synergy of human beings, society, economy, technology, science, and nature, to minimize harm to the future.

The most important finding of this study is the analysis of the genesis of the phenomenon of the RIS in the Greater Bay Area, as part of the national innovation system of China and the future global innovation system.

Global integration processes are now driven by corporations and supply networks, which determines the need to develop infrastructure to enter new markets and establish global processes – spreading information and expanding the spheres of influence of the leading global players. The development of RISs in the form of green, smart cities woven into national and global infrastructure is considered one of the scenarios of post-industrial society development.

Nevertheless, the study draws certain conclusions that the formation of specific RISs in China has been made possible by several factors, among which could be highlighted the adherence to the ideas of Deng Xiaoping's "Reform and Opening up" and Xi Jinping's "New Norm" of the innovation economy, cluster approach, infrastructure development and landscape-inspired green urbanism as a way to organize space in a post-industrial society.

The keys to understand modernity lie in history. The rapid technical revolution and industrialization that began in the second half of the 19th century went hand in hand with the breakdown of old orders, ideas, and ways of doing things. The agrarian society of the past was giving way to the

industrial society, which was to become the forerunner of the information society, which would probably become the basis of the society of the future: Society 4.0 or 5.0, the ″Harmonious World of the Future″ , as coined in the PRC.

Back in 1979, China was still a pre-industrial, developing, authoritarian and relatively closed country. A country where the real problem was the subsistence for the majority of the population. The country needed to change, and decided to do it along the lines of the changes already taking place in some East Asian countries, like Japan, South Korea, Singapore, Taiwan, and Hong Kong.

Deng Xiaoping developed a sketch of the ″Four Modernisations″ , incorporating the ideas of Liu Shaoqi and the program of then-Premier Zhou Enlai, which was even endorsed by the National People's Congress in 1975. In his strategy, maintained an emphasis on the socialist modernization of defense, agriculture, science, and industry, and did what Zhou Enlai could not do. He proclaimed that ″practice is the only criterion of truth″ and followed up the ″four modernizations″ with a 12-point program. The priority of economy over ideology was officially consolidated in the documents of the Third Plenum of the CPC Central Committee in December 1978. It is from this milestone that the period of ″Reform and Opening-up″ begins (Vogel, 2011; Tavrovskiy, 2018).

Deng Xiaoping and his team chose the strategically important region bordering the then colonial ″windows to capitalism″of Hong Kong and Macau to carry out economic reforms to introduce the ideas of a mixed economy of development and innovation. Before the policy of ″Reform and Opening-up″ , the provincial center of the city of Huizhou was the closest to Hong Kong. The area of present-day Shenzhen and its environs was then made up of scattered, sparsely urbanized settlements, most of which were poor fishing villages. It was these villages that were to become the first to experiment with the ideas of a state-regulated market economy. Development ideas were originally intended to improve the clothing and feed China's billion-strong population.

The achievements of the closely related ″Asian values″ and ″Confucian Civilisation″ of Singapore, South Korea, Hong Kong, and Taiwan were an example to follow because a combination of market economy and state regulation mobilized the resources of the nation, enabling them to achieve spectacular success and become industrialized and with an important service sector a matter of years. They also took from the legacy of Confucius, the terms ″Xiaokang″ , the society of average prosperity, and ″Datong″ , the society of great unity. (Wang, 2011; Vogel, 2011; Tavrovskiy, 2018).

The inclusion of the market with the socialist economy was reflected

when Deng Xiaoping proclaimed the principle: "It doesn't matter whether the cat is white or black, as long as it catches mice". Thus there was a symbiosis between a liberal market economy and a planned state economy under Communist Party control. This system was clothed in the theoretical framework of the "Reform and Opening-up" concept.

One of the main instruments for implementing the new policy was the establishment of experimental special economic zones (SEZs) which became the "calling cards" of the "Reform and Openness" policy around the world and the basis of future RISs.

In July 1979, the CPC Central Committee and the Chinese State Council approved the establishment of the first two SEZs on the border with Hong Kong and Macao – Shenzhen, and Zhuhai. It was decided to build a new city around Shenzhen–Luohu railway station with a population of a few thousand people and a single five-story building at the time. Very soon the "Shenzhen miracle" began. The SEZ authorities gained substantial autonomy, set low-income tax rates, and simplified rules for setting up mixed enterprises, obtaining visas, exporting profits, and exchanging currency. Researchers analyzing the reasons for Shenzhen's success have compared it to an "oasis" of the free economy or a "hoover" sucking in new technologies and production methods (Fang, 1994; Wang, 2011; Vogel, 2011; Tavrovsky, 2018).

China officially proclaimed the principles of accelerated development by applying the principles of market economy in the decisions of the National People's Congress in 1982, which set a target of quadrupling the GDP by the year 2000. At the same time, Deng Xiaoping adopted "socialism with Chinese characteristics" as the basis of his policy of "Reform and Opening-up". This ideological compromise subsequently ensured high rates of economic growth while preserving the planned economy as the material basis of Communist Party power. But it did not fully resolve the internal problems of Chinese society.

However, the systemic contradictions between socialist and market economy ideology, and liberal views, have not disappeared. The pursuit of profit at all costs led to the over-exploitation of workers, the seizure of peasant land for construction, the creation of more than two hundred million disenfranchised migrant farmers, an ecological crisis in megacities and industrial provinces, and distortions in regional development. Since the mid-'0s, GDP growth steadily declined to 7.4 percent in 2014. Local demonstrations in the cities and peasant demonstrations in the villages numbered in the tens of thousands. Corruption reached unprecedented proportions (Chase & Chan, 2016; Cao, 2020).

The gradual increase in wages in the export industries began to deprive Chinese goods of their competitive advantage – cheapness. The financial cri-

sis that broke out in 2008–2009 led to a further drop in demand for Chinese goods. China emerged from the crisis with minimal losses, not by emptying its financial reserves via banks offshore, but by building housing and infrastructure, administrative buildings, and cultural facilities at an unprecedented scale. This is when the infrastructure boom – the construction of motorways and high-speed rail lines that now criss-cross all of China began (Chase & Chan, 2016; Cao, 2020).

Xi Jinping became one of the nine members of the Standing Committee of the Politburo of the CPC Central Committee in 2007. Xi Jinping's rise to power coincided with the development of innovative economic ideas based on the five-point helix, cluster approach, and economic integration (Tavrovsky, 2018).

The reliance on intellectuals, the establishment of informal "think tanks" and non-statutory "small leadership clusters" become Xi Jinping's style in his current positions as leader of the CCP, the PRC, and the People's Liberation Army (PLA). Two weeks after the conclusion of the 18th CPC Congress (November 8–18, 2012), he set a long-term strategic goal for the ruling party and the people as a whole, entitled "the Chinese dream of the great rebirth of the Chinese nation". He set a two-stage timeline: by 2021, the 100th anniversary of the founding of the CPC, to build the middle-income xiaokang society that Deng Xiaoping had promised; and by 2049, the 100th anniversary year of the CPC, to transform China into a "rich and powerful, democratic and civilized, harmonious society of the future".

In tackling the key question of choosing the optimal economic model, Xi Jinping concluded about the crucial role of science and innovation in the development of the national economy. In his speech at the 100th anniversary of the CCP he mentioned:

"Our country faces significant contradictions and challenges in the process of development and encounters many difficulties and problems along the way. For example, the issue of uneven, non-harmonious, and short-lived development remains acute. China is not strong enough in scientific and technological innovation, the industry structure is characterized by irrationality, the extensive development model is still used in many areas, and the gap between urban and rural development and the income level of different people is still increasing. Social contradictions have become considerably more acute, and a lot of issues have accumulated that are closely related to the primary interests of the population in the areas of education, employment, social security, medicine, housing, ecology, food and drug safety, industrial safety, public peace, enforcement of laws, and so on. The unprotected part of the population is experiencing great difficulties in life. There are also manifestations of formalism, bureaucracy, hedonism, and wastefulness. Corruption

and other negative phenomena are recurrent in some of the most vulnerable areas, and the anti-corruption situation remains very acute. Deeper reforms are needed to address all these issues" (Xinhua, 2021).

The most profound of the reforms prepared by Xi Jinping were called "xin chantai" ("new normal" or "new norm"). Essentially, it meant, at a minimum, adjustments to the development agenda outlined by Deng Xiaoping back in 1978. The policy of "Reform and Opening-up", developed in crisis conditions and consisting of hastily fitted together components of socialist economy and market economy, has fulfilled its historical role. China has moved away from the brink of chaos and self-destruction through adventurous "leaps and bounds" and "cultural revolutions".

The point of this system is that the period of the high-growth race, in the name of which disproportionate economic development was allowed and the interests of the population and the environment were sacrificed, was coming to an end. This is the dawn of a high-quality economic structure, a balance between sectors and regions, more efficient investment and less energy intensive, less polluting emissions, an innovative, sustainable economy, and green urbanism.

The period of betting on foreign markets and attracting foreign investment at all costs was over. It was a time of prioritizing domestic market demands, qualitative improvement, and convergence of urban and rural livelihoods, producing high-quality and competitive goods in their own chains, based on the achievements of global science.

Since 2017, RISs or clusters of megacities have become the new norm in Chinese urbanism. The priority was to build five so-called megacities, across the country – the Great Bay Area (GBA), the Yangtze River Delta, the Beijing–Tianjin Hebei area (Jing-Jin-Ji), the Middle Yangtze River area, and the Chengdu–Chongqing urban agglomeration. Supercities will be linked to countries and regions across the Eurasian continent and beyond.

These global infrastructure and innovation projects were reflected in China's "Vision 2035", part of the 14th Five-Year Plan (2021 to 2025). China's President Xi Jinping articulated the 2035 vision in somewhat subdued terms, calling it transforming China into a "moderately prosperous country" by that date. Nevertheless, the consequences of achieving even this assumed modest level of economic development will entail a great shift in China's relations with the rest of the world (Chen & Xie, 2018; Atha et al., 2020).

In terms of China's development in the Asian region through the Regional Comprehensive Economic Partnership (RCEP), the agreement could have significant implications for expanding intra-regional supply chains, value addition, increasing the comparative advantage of manufacturing between different countries and further attracting cross-border investment as China

outsources manufacturing. The RCEP as the next step of the GBA development will become the world's largest free trade area. Its 15 member states, home to 2.27 billion people, have a total GDP of $26 trillion and total exports of $5.2 trillion (Flach et al., 2021).

More specifically, from an industry perspective, China will be a major source of investment in all RCEP value chains, offering advantages to regional producers. For example, the Japanese auto industry is expected to benefit from Chinese household demand for vehicles. Singapore will benefit mainly from increased shipments of chemical and petroleum products to China. Vietnam will focus more on electronics and mechanical engineering. Lower-income countries would also benefit from a significant shift in the textile and garment industry from China to a lower-cost base.

The experts assume that the Chinese and Hong Kong economies will reach $41.8 trillion by 2035, a fraction below the US and Japanese economies combined at around $42.3 trillion. According to official Chinese forecasts, by that date, China will also have an estimated GDP per capita of $30,000. This will further boost its growth as the world's largest consumer-driven economy in the coming years (Chen & Xie, 2018; Atha et al., 2020; Flach et al., 2021).

The 14th Five-Year Plan sets new targets for China's urban growth. These include plans to facilitate the settlement of about half of the rural migrants in five clusters, RIS, including the Beijing–Tianjin–Hebei (Jing-Jin-Ji) area, the Yangtze River Delta, the Middle Yangtze River Area, the Great Bay Area (GBA) and, most recently announced, the Chongqing–Chengdu urban cluster. While there are other smaller urban clusters, these five clusters are being promoted as regional, power, socio-economic, and cultural centers. Each will be designed both to provide "internal circulation" and serve as hubs to facilitate "external circulation" between China and the global economy. The population of these will be a staggering 600 million, equivalent to the population of the European Union and the Russian Federation combined (Han et al, 2021).

The process of urbanization in China has been going on for decades. It is necessary for the country's economic growth strategies. This ongoing movement of people from rural communities to urban environments is likely to continue for the foreseeable future, with the possibility that the urbanization rate could rise to three-quarters of the population by 2030, from 62 percent in 2021 (Lam & Fong, 2022).

Major investments are already underway in these regions, which partly explains the recent infrastructure expansion and accompanying, soaring global prices for base metal commodities. In this effort, central and provincial governments are channeling resources into the development of smart grid technologies, new high-speed railways, advanced 5G networks, autonomous

driving and electric vehicles, and other forms of advanced mobility, and big data systems.

At the current rate of development, the GBA has already become a key international hub for advanced manufacturing. It is also home to many innovative and technological companies in the world. These are complemented by a growing soft infrastructure of finance, tourism, leisure, and other creative industries. As such, Hong Kong is an ideal center for financial and professional services, serving as a platform for international capital flows between global financial centers and the GBA as well as other across China.

RISs will play a more prominent role as centers for piloting new domestic policies and new technologies, and linking China with the world.

"Dual circulation" introduces some new concepts for the expected in 2035. This mainly manifests itself in new technologies, such as digital currencies and blockchain, which will be developed to ensure reliable and secure international supply chains. The new standards and protocols that will be set within the current globalization paradigm, led by China, has the proposal to create a more regulated and equitable form of globalization that emphasizes sustainable development, inclusiveness, green technology, and a greater balance between the needs of large corporations and the rest of the economy.

In particular, greater recognition by governments, the role of local suppliers, and the SME sector can be expected, as well as more opportunities for developing countries to develop and achieve higher living standards for their people. This will include lower-income countries in Southeast Asia and South Asia, from the Russian Far East to the Middle East, from Africa to Central and Eastern Europe, and possibly on to Latin America and the Caribbean, where developing countries are increasingly joining China's "One Belt, One Road" program.

The conceptual significance of the digital economy for national and world society is based on the use of knowledge, technology, and information as a fundamental system in forming the basis for post-industrial development. The digital economy, the basis of the modern stage of the industrial revolution, is information and communication technologies, which are part of convergent technologies that are intensively entering the global way of life. Digitalization implies increasing complexity of the processes of interaction between individuals, society, business structures, and the state, accelerating and intensifying the virtualization of the constituent elements of economic relations.

Cluster "ecosystems" are formed as a way of organizing space and society in the digital age and are designed to significantly increase prosperity and minimize resource costs. Recently, there has been a tendency to use "digital economy" , a term associated with the current state of development of the

global economy. The digital economy (related also to Shared Economy, Platform Economy, Industry 4.0, Society 5.0) – is a system of economic, social, and cultural relations based on the use of information and communication technologies. In the Development Strategy of the 14th Five-Year Plan and Xi Jinping's Vision 2035, the digital economy is fixed as an economic activity for which digital data, its processing, and the use of analysis results are the key production factor, allowing for significant improvements in the efficiency of various types of production, technology, equipment, storage, sale, delivery of goods and services. The digital economy is understood as a set of networked technologies, regional and local innovation clusters and systems, smart machines, and people, united for a breakthrough in creating a harmonious society of the future (Ma & Zhang, 2019; Ma et al, 2021).

Thus, modern Chinese cities and metropolises of the future are developing a digital economy in the form of regional innovation systems based on the knowledge economy. Knowledge and information as necessary effective assets have the characteristics and features of the new post-industrial era:

- Knowledge and information are global in their manifestations on a planetary scale;
- No territorial spatial distribution constraints;
- In the chronological range of the evolution of global society, the volume of information is constantly increasing;
- The generation of new knowledge as a resource has unpredictable consequences depending on the degree of intensity and variations of the involvement of key agents with different goals and motives in achieving the desired future in the creation of development factors;
- Contemporary reality is an environment in which knowledge and information can acquire the format of service with a rapid speed of dissemination to the final consumer;
- The same or similar knowledge and information can be used repeatedly in different temporal and synchronous sequences and by different entities;
- Knowledge and information are a form of human activity subject to multiple transmissions and transfers, which do not diminish in value as an asset but, on the contrary, can increase in new derivatives leading to the enhancement of the welfare of world civilization.

Digitalization as a fundamental tool for integration of regional systems and megacities of the future is a systematic approach to engaging digital resources in economic, social, urban, and other activities, which leads to changes: for example, productivity increases due to information and communication interaction space, the competitiveness of products and services in certain market niches and relevance with the target audience increases. Digital transformation envisages a platform as a tool for interaction between residents of economic ecosystems.

A harmonious balance of technological capabilities and ecosystems, with a proper sequence of their concentration and use in the form of technological platforms, is a foresight strategy for global technological development, including the formation of the shape of China's digital civilization. Cloud technologies, the Internet of Things, big data technologies, and artificial intelligence have a high potential for growth. This relevance is particularly significant in the post-coronavirus era when the convergence of digital technologies with the previous processes of society's everyday existence is increasing. In terms of industrial capacity development and related industries, the concept of cyber-physical systems is most relevant.

These systems represent the aggregate potential for synergy and emergence of information-computing resources and application-format processes represented by the combined application of infrastructure and information systems. Such technological quintessence is applied within Chinese regional systems, both in single production and in aggregate enterprises, including those that are part of a cluster structure. Digital technology has gained the most penetration in e-commerce systems based on regional and global digital platforms.

RISs as clusters of smart cities, accumulate global scientific and technical experience in the organization and management of socioeconomic space and at the same time represent a unique phenomenon of the modern mega-cities in southern China. Each of them is the seed of both an innovative system and a "time and place" social and technical experiment, with the coherence and speed of the dissemination of ideas for creative purposes. In this respect, the phenomenon of Chinese innovation systems, the so-called "Cities of the Future", in particular, the Great Bay Area, is difficult to replicate elsewhere.

Under the conditions of social and economic uncertainty caused by destabilizing factors (disasters, epidemics, international and local conflicts), it is difficult to predict the development of the Great Bay Area as part of the global integration initiatives "Belt and Road" and "21st Century Maritime Silk Road". Since all global initiatives are sensitive to the international conjuncture and are based to a certain extent on the conditions of economic and social circumstances the development of systemic processes is not always

linear, and hence failures and integration pauses caused by global and local turbulence should be temporary.

The development of the Greater Bay Area has proceeded apace in several stages, and an important part of this process has been the development of science and education. The development of science is an integral part of innovative progress and urbanization. Also, the development of scientific knowledge has helped humanity to use resources more efficiently and develop measures to promote a sustainable and ecologically environment and society.

Further research plans are connected with the study of experimental cities, innovation and education clusters in China which develop in the paradigm of knowledge economy. Studying the experience of implementing experimental innovation clusters in various regions of China, analyzing the processes of their creation and formation. As well as the specifics of their interaction with each other and with the global innovation system.

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