Chapter 2
Theoretical and Practical Research in the Context of Regional Synergistic Development

Abstract This chapter provides a research overview of the related theoretical concepts and practical examples of synergistic regional development. The solution to regional development imbalances from the path of regional cooperation is one of the main objectives of this theory. It provides theories on how regions can develop synergistic collaboration in the areas of economic, environmental and social structures and how these theories can be practised into practical strategic implementation programmes for sustainable regional development. Firstly, we introduce the conceptual and theoretical background of synergistic regional development in the form of urban agglomeration discussed from the perspective of the urban planning discipline. Then we analyse and evaluate cases of synergistic regional development that reflect the research results of regional cooperation. Finally, we explain the advantages and difficulties of forming a synergistic development of Hengqin and Macao.

Keywords Regional synergistic development · Theoretical and practical research · Hengqin and Macao

2.1 Introduction to Related Theories

In urbanisation, a region or city has a certain degree of unbalanced development due to various factors, such as natural conditions, resources, production, innovation capacity and ethnic, religious and cultural differences. It includes the imbalance in the degree of economic development, the level of public services, the innovation potential and the sustainability of development (Fan, 2011), which triggers the need for positive value development. It is called the justice of urban areas. However, synergistic regional development is a homogeneous demand for city–regional justice (Gao, 2016), and synergistic regional development is a path to solving the problem of regional development imbalance. In this review, we aim to explore the theory of synergistic regional development in the context of urban planning discipline and based on the relationship between cities and regions. The following section reviews the theoretical development and concepts of cities and regions for synergistic regional development.

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Cities are the products of human civilisation at different stages of development, and the origin of cities needs to be discussed with the development of human civilisation. The origins of the Western city are explored in the book 'The City in History: A Powerfully Incisive and Influential Look at the Development of the Urban Form Through the Ages' by American urban theorist Lewis Mumford. The author argues that there are many manifestations of the process of city production, its functions and the purposes for which it was intended, and it is not easy to summarise it into a single definition. The development of the city has different and rich stages, such as the social core of its embryonic period, the complex forms of its maturation and the decomposition and collapse of its ageing period. Mumford mentions that amongst the early human non-permanent settlement forms, it has two forms related to gods and rituals. In the stage of non-permanent settlement, Mumford believes that before the city became a permanent human settlement, its initial function was to provide meeting places for humans. These locations would periodically bring humans together for sacred events, where humans could interact and communicate. This setting was one of the essential criteria of a city and an evidence of its vitality. Thus, the earliest human ceremonial gathering places, such as sites of ritual and religious veneration. They were the embryonic form of urban development. With development, non-permanent settlement forms transitioned to permanent settlement forms. During the Palaeolithic period, the remains of buildings that seemed to be primitive settlements were found, and the Neolithic culture period was a time when agricultural villages and towns were not yet widely formed; however, by this time, humans knew how to probably choose favourable locations for these future villages and towns, such as locations with abundant water resources, rich fish and shellfish resources and convenient transportation. In the course of later studies, it was discovered that a large number of hills with shells were found in these locations. These form the evidence of permanent settlement, a primitive form of the small village. Then later, during the Neolithic, new village settlement centres emerged, and the primitive villages and surrounding plots constituted new types of settlements. During the Neolithic period, humans began to develop agriculture, invent various technologies and build primitive village structures, including houses, stoves and barns, etc. With these structures and the way of life of people living close together in villages, the order and stability of towns would continue and be transmitted to later cities. All of these prove that the primitive forms of cities already appeared in the primitive Neolithic villages and that cities evolved from these primitive villages. The city began to take shape gradually, and it became richer and more prosperous. The change in the original settlement form proves that early cities existed. At the same time, human beings carried out activities to transform the natural environment. The above factors and evolutionary processes provided a solid foundation for the formation of later cities. The method of human civilisation was an important driving force in the development and formation of cities, which later developed forms of urban organisation thanks to the foundations left by ancestral humans.

The city emerged as a new thing amongst the Palaeolithic and Neolithic communities, which gradually took shape as it developed. As a result of the limitations of the form and ability of the original village, the promotion of an actual city required

a new factor to drive it. Innovations were introduced to the primitive villages in the process of development. Under the influence of new factors, the basic form of the primitive village began to become complex and unstable, and the human organisation began to become more complex, and the transition from primitive villages to cities began during this period, similar to the case of the Sumerian states that established slaveholding city-states in the twenty-fourth century A.D. Owing to the rise of cities, which brought together many social functions within a limited geographical environment, it became regular and organised. The composition of the social structure began to be further differentiated, and each part became the prototype of the various constituent structures of urban culture. This was followed by the emergence of castles, such as Khorsabad, an ancient city in northern Iraq, which was a capital city in the seventh century BCE. Finally, in 2500 B.C., all the basic features of the city were formed (Lewis, 1961). There have also been many discussions amongst scholars about the origin of Chinese cities. Although China's urban development characteristics are similar to those of Western cities, they still have the features of Chinese cities themselves. The driving force of the initial urban emergence in China was agriculture. Around 8000 B.C., grains and rice were found in the middle reaches of the Yellow River and the Yangtze River, and they symbolise the local dynamics of local origins and agricultural development. The driving force of the initial urban emergence in China was agriculture. In the Middle Neolithic, around 6000–5000 B.C., a settled life based on farming emerged in China. Having a large number of settlements in the basins and plains, they were still spreading at that time. From 4000 to 2800 B.C., agriculture and handicrafts were further developed, contributing to the transformation of society at that time, and a primitive civilisation gradually emerged. Human organisation and social structure became complex, ruled by an elite class that held power. Until the late Neolithic period, the size and number of settlements increased more than tenfold because of technological and social changes, and primitive cities gradually formed. These cities were bastions of the elite ruling class of the time, who built walls and owned a moat. As of the small size of these cities, they could not accommodate entire tribes or entire groups, thus creating a difference between urban and rural areas with the surrounding villages, such as Chengtou Mountain in Hunan Province. At this time, the primitive cities had some order and planning. From 3000 to 2200 B.C., the social characteristics of the Longshan period emerged in different regions of China, including the development of handicrafts and religious practices, the development of agriculture and the formation of classes and the emergence of cities.

However, the region's development is inseparably linked to the city, and some scholars believe that the city represents a special region and is the centre of areas of different sizes. Urban Science, which treats urban areas as objects of study, is a branch of regional science. Cities are the basic constituent units of regions. The region and the city are a relationship between the whole and the part, influencing each other. A region is a contiguous geographical space where somehow there exists a unified economic and social system. From the perspective of regional science, it integrates theories and methods from multiple disciplines, such as economics, political science, architecture, transportation science and urban planning (Yang, 2019).

Regional spatial structure types are divided into rural and urban areas, with rural areas being large in scope and dominated by agricultural production activities. Non-agricultural activities dominate urban areas, and it also has the function of driving rural areas. From the characteristics of regional spatial layout, the regional transportation routes are shown as lines and networks, cities as points and urban clusters as islands. This chapter discusses the implementation of synergistic regional planning mainly in urban agglomeration mode. The origin of the region from the perspective of urban agglomeration can be traced back to the concept of the 'Garden City' proposed by Howard, a British social activist, in 1898. The 'Garden City' consists of two parts: the city and the countryside, with the city at the centre and a park at the centre of the city. Its six main roads radiate outward from the centre, dividing the city into six districts, and the outermost circle of the city is built with factories, warehouses and markets. Transportation is convenient with the outermost ring road on one side and a circular railroad spur on the other. When the number of people exceeded the capacity of the 'Garden City', Howard believed that over time the 'Garden City' would form an urban agglomeration, transforming into a complex of central social cities in the context of the environment where the subway had already appeared. Several garden cities surround the central city, which together forms a cluster of cities with agricultural dividers, and this central city will be larger. The cities have intertwined radial roads and intermunicipal railways. There are radial roads between the central city and each of the garden cities; on top of them, there are underground railways and circular intermunicipal canals. The extensive canal traffic line along the edge of the central city radiating to each garden city is accessible to the sea. The colonial cities are connected by transportation, water supply and drainage facilities to form a whole system. This urban agglomeration was described by Howard as a 'ghetto-free, smog-free urban agglomeration'. In 1899, Howard founded the 'Garden City' Association, and he was an active promoter of social reform. In 1903, the first generation of the 'Garden City' practice emerged in the London suburb of Letchworth. This was followed by a second generation of 'Garden City', which was also called the satellite town in Welling. Regional planning was formally introduced in 1915 by Patrick Geddes, who was one of the pioneers of regional planning theory. In his book 'Cities in Evolution: An Introduction to the Town Planning Movement and the Study of Civics', he proposed that the emergence of new technologies (electricity generation, the internal combustion engine) was leading to the evacuation of large cities and the formation of clusters. These clusters of regions and cities were called 'Conurbations'. He predicted the emergence of a megacity belt in Europe and the United States (U.S). Half a century later, his theory influenced Jean Gottmann's study of megalopolis zones (Hall, 1978). In 1933, German geographer W. Christaller proposed the theory of central location, which is the centre of the surrounding area; it is the centre of a city or a large gathering of residents, commerce and services. This theory defines the spatial organisation and structure of cities and urban agglomerations. It gradually developed into a basic theory for regional development and analysis (Fang & Yu, 2017). In 1957, French geographer Jean Gottmann published the study 'Megalopolis: or the Urbanisation of the Northeastern Seaboard'. The object of his

study was the widely distributed contiguous megalopolis located along the north-eastern coastline of the U.S. It is a cluster of large numbers of people, industrial and commercial facilities, financial wealth and cultural activities that no place can compare. Jean Gottmann argues that urban agglomerations are formed via the role of agglomeration and develop in the form of a network structure. These regions develop around a strong urban nuclear energy source (Gottmann, 1957). At the same time, the author mentions two factors that contribute to the contiguous development of urban agglomerations: firstly, the polynuclear origin, and secondly, the role of the 'hinge'. The authors provide an explanation for the identification of the role of the 'hinge'. He gives the example of the U.S. East Coast, which has assumed the role of a window for developing overseas relations, serving as a springboard for settlement and development in the interior. Whether the U.S. economy is moving overseas or shifting inland, the East Coast has always held the primary position. The U.S. also has the North American Great Lakes City Clusters and the San Diego–San Francisco City Clusters on the Pacific Coast of the south-western U.S. Other countries have formed several of the same city cluster regions, including the London City Cluster in the UK, the Paris City Cluster in France, the Ruhr City Cluster in Germany, the Randstad City Cluster in the Netherlands and the Pacific Coast City Cluster in Japan. Firstly, the emergence and development of foreign urban agglomerations are based on industrialisation and the division of labour amongst cities, which develop in the modes of core cities driving surrounding cities or multi-centre synergy. Both modes take advantage of each city's resources to maximise the region's overall benefits, for example, economic, political, high-tech and foreign trade resources. In addition, they focus on the linking function of a well-developed transportation network. Cooperation amongst cities in urban agglomerations and the formation of a complete system must rely on a well-developed transportation network. Most foreign city clusters have well-developed regional transportation infrastructure networks. Amongst them, well-developed railway and highway facilities constitute the skeleton and linking hub of the spatial structure of foreign city clusters. Secondly, they also focus on the coordination role of government, and secondary cities focus on dislocated development with core cities (Wang, 2005).

We want to explain here a concept of synergy, which was introduced in Hermann Haken's book 'University Translation Series–Synergetic: The Mystery of Nature's Composition', which was published in 1969. He formally created the concept of synergy, and the author hoped to find common principles that would apply to very different fields of science and that the theory of synergism would likely appear in different disciplines. Synergy means coordinated cooperation, and it is derived from the Greek language. Synergy was created to solve the problem of how parts form a whole via synergistic collaboration (Haken, 1969), and it explains the relationship between the whole and the parts. This principle plays the same supporting role for the theory of synergistic regional development. In the 1980s, Jean Gottmann's concept of the urban agglomeration concept to China in the book 'Introduction to Urban Geography' by Ning Yuemin, which has been influencing Chinese urban agglomeration planning. The driving force behind urban clusters and regional synergies in China is

the need for such a synergy between the national economy and the country's overall competitiveness.

The 11th Five-Year Plan for National Economic and Social Development of the People's Republic of China proposed that urban agglomeration is the main form to promote China's new urbanisation. It will gradually form with the coastal and Beijing–Guangzhou and Beijing–Harbin lines as the vertical axis, the Yangtze River and Longhai lines as the horizontal axis, multiple city clusters as the main body, other cities and small towns distributed in a dotted pattern, and permanent arable land and ecological functional areas spaced apart. In this manner, an efficient, coordinated and sustainable spatial pattern of urbanisation can be created. China has already formed city clusters, such as Beijing–Tianjin–Hebei, Yangtze River Delta and Pearl River Delta regions, and they continue to play a driving and radiating role in strengthening the division of labour and cooperation amongst cities within city clusters and play a complementary and advantageous role to enhance the overall competitiveness of these regions. Regions with conditions for urban cluster development should strengthen integrated planning, with mega-cities and large cities as the leading cities and playing the role of central cities. Multiple new city clusters with less land, more employment, strong factor gathering capacity, and reasonable population distribution will be formed (State Council, 2006). China has approved nine city clusters, including the Yangtze River Midstream City Cluster, Ha–Chang City Cluster, Chengdu–Chongqing City Cluster, Yangtze River Delta City Cluster, Central Plains City Cluster, Beibu Gulf City Cluster, Guanzhong Plain City Cluster, Hubao–Egyu City Cluster and Lanxi City Cluster. During the 13th Five-Year Plan period, China proposed a strategic path of spatial integration of urban agglomerations to drive synergistic regional development, such as the Yangtze River Delta Integrated Development Strategy, which has achieved remarkable results. In the 14th Five-Year Plan period, China will continue to deepen and improve the overall regional development strategy based on the new type of urbanisation and endeavour to design new strategic paths for the synergistic development of urban agglomerations in the four major regions (Wei & Li, 2020).

The above review is a chronological review of the theories and concepts of urban origins and evolution, development from cities into regions, and regional synergy in China and the West. As Patrick Geddes stated, cities will develop through five stages, the second and third of which is the gradual aggregation of cities into a large urban region. Urban agglomerations are the result of the evolution of urban spatial forms. In the current environment of economic globalisation and regional integration development, often city clusters are the main arena of competition between countries and countries and between regions, and synergistic regional development is an inevitable trend. It reduces the gap between regions and improves regional competitiveness via the association of multiple cities in economic, resource and geographic space. It is a process in which two or more cities or urban functions achieve their goals by means of spatial aggregation. These cities share common interests and common destinies. At the same time, the strategic decisions of countries in different periods will influence the synergistic regional development into a new stage, and synergistic regional

development has become an important research theme in various fields. In the next section, we review and comment on domestic and international cases of synergistic regional development.

2.2 Cases and Roles

The purpose of synergistic regional development is to achieve sustainable regional development and enhance regional competitiveness. There have been many domestic and foreign cases of synergistic regional development, which provide a rich experience for our strategic practice of synergistic regional development. Then, we elaborate on the synergistic development of the cases in terms of the two aspects of industrial layout and transportation. Finally, we analyse and summarise the domestic and international cases.

The industrial layout is the adjustment, overall layout and planning of the industrial structure. The structure of the region includes the regional industrial structure and the regional spatial structure. The regional industrial structure is also an essential part of promoting regional development, which is influenced by natural geographical conditions, economic development level, resource allocation status and labour quality. The economy is one of the factors affecting the industrial structure, and urban development planning cannot be separated from the urban economy. At this stage, major Chinese cities propose to optimise the industrial layout, which is one of the paths to promote regional industrial synergy. Meanwhile, strengthening transportation infrastructure is also an important element of synergistic regional development.

Take the Yangtze River Delta City Cluster, which is more mature in synergistic development in China, as an example. The development model of the Yangtze River Delta City Cluster is based on the national central city as the core. From an economic perspective, the Yangtze River Delta urban agglomeration is one of the most dynamic, open and innovative regions in China. It is also an important intersection of China's Belt and Road Economic Zone and the Yangtze River Economic Zone. The Yangtze River Delta City Cluster is further developed by means of a higher level of international cooperation and competition. It plays an essential role in supporting and leading China's economic and social development. The Yangtze River Delta City Cluster mainly includes cities in Shanghai, Jiangsu, Zhejiang and Anhui provinces and other cities within these four provinces. With Shanghai as the core, several cities are linked to form a cluster. China's planning period for this region is 2016–2020, with a long-term outlook to 2030. In the direction of synergistic development of industrial layout and transportation facilities construction, the document 'Yangtze River Delta City Cluster Development Plan' clearly proposes to promote the synergistic development of Shanghai and neighbouring cities, such as Suzhou, Wuxi, Nantong, Ningbo, Jiaxing and Zhoushan, to play a guiding role for the integrated development of the Yangtze River Delta City Cluster and to enhance the ability to serve national strategies, such as the Yangtze River Economic Belt and the 'Belt and

One Road', to build a transportation infrastructure with reasonable layout, perfect function, safety and efficiency whilst improving the interconnection of transportation facilities, establish a comprehensive transportation network mainly based on railway transportation and improve the intercity comprehensive transportation network. On the basis of the national comprehensive transportation corridor, with Shanghai as the core and Nanjing, Hangzhou and Hefei as the subcore, build a multi-level integrated transportation network mainly with high-speed railroads, intercity railroads, expressways and the Yangtze River Golden Waterway (National Development and Reform Commission, 2006). The Yangtze River Delta City Cluster has also established the Yangtze River Delta Regional Cooperation Office, which is able to participate in the overall management and supervision of implementation actively and can better actively guide enterprises and various sectors of society to join the cooperation.

The total planned area of Shanghai Hongqiao Business District is 86.6 km^2 to build an international open hub leading the integrated development of higher quality in the Yangtze Delta region. Through this business district, a driving effect on the surrounding areas will be formed, eventually forming a unique integrated business district.

The construction planning of Suzhou High-Speed Railway New City in Jiangsu Province started from the development of Suzhou Xiangcheng District and the strategy of expanding the northern part of Suzhou city, which is positioned to build a national high-speed railway hub and a hub of the intercity railroad network in the core region of Yangtze River Delta. It forms a 'double cross' transportation hub with the Nantong–Suzhou–Jiaxing–Ningbo high-speed railway line, Suzhou and Huzhou intercity railroad, and Suzhou, Wuxi and Changzhou intercity railroad intersecting at Suzhou North Station. At the same time, it deepens the strategic cooperation with Shanghai Hongqiao Hub to create an integrated hub of Shanghai and Jiangsu. The industrial planning of this area is positioned as the new gateway to Suzhou, the new home of the city, the new industrial highland and the new ecological space. With global services as the scope, it will innovate the process of one-stop trade services and create a trade service platform based on the Yangtze Delta region and connected to the world via cross-border cooperation. It uses the Yangtze River Delta International Research and Development Community to develop industry–academia–research activities with Shanghai universities, including big data, industrial Internet, financial technology and other aspects, to achieve the transformation of 'science' to 'technology' to 'industry' and improve the regional innovation chain in this manner. It has built a film and television industrial park, with film and television, exhibition, e-sports, games and creative design as the main industry, with the aim of cultivating professionals in these fields by means of the form and function of the industrial park and improving the living facilities of the region. Moreover, this area relies on the medical resources of the Chinese Academy of Medical Sciences, the University of Washington School of Medicine and Johns Hopkins University School of Medicine to jointly build an international medical and health centre, which strengthens the synergistic innovation with Shanghai medical technology and cultivates medical talents through a transnational joint manner. Summarising the above point, the trade service platform industry, high-tech industry, cultural and creative industry and medical and

healthcare industry in Suzhou, Jiangsu Province's high-speed railway new city, have strengthened and promoted the regional industrial synergy development via cross-border cooperation, integration of industry, academia and research for industrial aggregation.

Driven by market-oriented mechanisms, the new high-speed railway city in Jiashan County, Jiaxing City, Zhejiang Province, was developed in integrated public–private partnership mode. It identifies development positioning, such as a new centre for urban development, which is a significant platform for industrial innovation, and the creation of industrial clusters, such as life medical care, intelligent automobiles, business services and film and media. At the same time, it strengthens synergistic cooperation with Shanghai. It takes over the transfer of talent resources from Shanghai to Jiashan County based on the talent entrepreneurship park in Shanghai. Shanghai is the beginning of the development of this region, and the process of this region's development is in Jiashan.

With the official opening of Bengbu South Station of the Beijing–Shanghai High-Speed Railway in 2011, the planning and construction of Bengbu High-Speed Railway New City in Anhui Province began, with a total area of 41 km^2. Its regional planning is positioned as a bearing area for the implementation of Bengbu's 'two centres' strategy, a pilot area for the integration of Bengbu City, Huaiyuan County, and Fengyang County, a leading area for modern city construction, a cluster area for medium and high-end modern service industries and business support, and a new highland for science education, innovation and entrepreneurship. In 2020, Bengbu City High-Speed Railway New City was again upgraded industrially, mainly positioned for the development of science and innovation industries. According to the actual development of Bengbu High-Speed Railway New City, the way of industrial structure adjustment in the early stage is the mode of industrial gathering, and the mode of industrial upgrading in the later stage, which strives to form a regional industrial gathering place with certain influence via the method of regional industrial structure adjustment. At the same time, Bengbu High-Speed Railway New City takes Bengbu West Station as the core for spatial planning, integrating public transportation resources and forming a regional comprehensive transportation hub.

The Northeast Atlantic Coastal City Cluster of the U.S. is a contiguous metropolitan area that includes Boston, New York, Philadelphia, Baltimore and Washington. It spans 12 states and 1 special district. The Atlantic Coastal Cities cluster in northeastern U.S. has developed a core system of knowledge-intensive industries, such as finance and information. City government agencies and civic groups largely coordinate this urban agglomeration. The northeastern Atlantic coast of the U.S. is mainly dominated by the financial and business services industry and is called the 'Financial Bay Area', based on the Port of New York, which has gradually become the core of the U.S. economy. In 2016, the Northeast Atlantic Coast metropolitan area of the U.S. was the top two in terms of GDP for real estate and insurance, and it has a tertiary sector share of more than 90%. Furthermore, major world financial and securities firms are clustered here, creating an excellent financial industry base. The structure of the Northeast Atlantic Coast of the U.S. is hierarchical,

with the first tier of cities being New York, the second tier being Boston, Philadelphia, Baltimore and Washington, and the third tier comprising approximately 40 other small- and medium-sized cities. New York, Boston, Philadelphia, Baltimore and Washington have their own strengths and different leading industrial resources. New York is represented by financial and business industries, high-tech industries are concentrated in Boston, and industries, such as clothing, cosmetics, printing and oil, military and metal products manufacturing, are focused in the area around Manhattan. The defence, aviation and electronics industries are gathered in Philadelphia, and the mining and shipping industries are gathered in Baltimore. These five cities implement a strategy of dislocated development and complementary resources, and New York and its surrounding cities have formed a pattern of synergistic industrial development with diversified, comprehensive and complete industrial chains, which provides the foundation and guarantee for the industrial development of the Atlantic Coastal City Cluster in northeastern U.S. On the basis of the spatial and industrial structure, the transportation system of northeastern U.S. urban agglomeration is gradually integrated. The air transportation industry in the Northeast U.S. City Cluster is highly developed, and the three airports of JFK, Newark and LaGuardia constitute a world-class aviation corridor. The airport construction is organically integrated with the ground highways and railroads, maximising the efficiency of air transportation. Transportation within the urban agglomeration is dominated by highways and railways, with railways bearing the majority of passenger traffic. Passenger and cargo transportation within the city limits is dominated by road car transportation. New York City has a special system of passenger rides with in-station transfers at the entrances to the city. This measure enables integrated transfer services between private cars and buses, road transportation and rail transportation. It enhances the convenience of transportation within urban clusters and promotes the two-way flow of resource factors.

The Rhine–Ruhr urban cluster in Germany has one city of one million people and nearly 30 small- and medium-sized cities. The Rhine–Ruhr region is rich in coal and water resources. It has convenient water and land transportation conditions. In the 1950s, to reduce the logistics costs of importing mineral resources, the German Rhine–Ruhr City Cluster underwent an industrial transfer, with steel companies moving from the inner cities to the port cities. Duis is a port city, and this area is mainly clustered with heavy industries as leading industries, such as logistics, steel and petrochemicals. The headquarters economy of the Rhine–Ruhr City Cluster is in Cologne, where the leading industries are insurance, media, conventions and headquarters economy. In Düsseldorf, there are leading industries, such as communication, advertising, finance, convention and exhibition and the headquarters economy. The cities of Cologne and Düsseldorf have the advantage of transportation hubs. In the 1960s to the 1980s, high-end elements were concentrated in Cologne and Düsseldorf to share with surrounding cities, creating cloud and chain synergy. The high-tech industry was concentrated in Dortmund, which included new and high-tech industries, such as electronic information and biological hospitals. In the 1980s, core resources in the city cluster were integrated. Dortmund establishes technology centres with Essen and Duisburg. Companies and research institutes cooperate to

create a technological path in the Ruhr. In the Rhine–Ruhr City Cluster, information and talent assist the tertiary sector and technology in collaborating within the city cluster by means of cloud-like synergies, promoting the development of new industries and the formation of industrial chains.

The Ruhr region has a well-developed transportation network, and it is the intersection of Europe's major east–west and north–south transportation routes. It has the largest river port in the world, busy inland waterways and the densest rail network. Dusseldorf has the third largest international airport in Germany, and the region is extremely convenient for highways. The different modes of transport use their strengths to form a unified and coordinated integrated transport system in the Ruhr. Thus, the Rhine–Ruhr urban agglomeration has a well-developed regional public transport system with rail as the backbone, based on good transport infrastructure. The railway is operated in verkehrsverbund mode. The railway is planned, managed and operated by the Verkehrsverbund Rhine–Ruhr, which is the coordinating organisation between the government and the specific operating companies. The railway network skeleton includes high-speed railroads, suburban railroads, subways, light railways and trams. It connects large and small cities in urban agglomerations. It is characterised by punctuality, speed, comfort and safety. The Rhine–Ruhr urban agglomeration is highly integrated via the interconnection of different modes of the railway. Installing safe and quick mini-transfer feed stations is an easy transfer between rail transit and buses, bicycles and private cars. Bus stops, secure bicycle storage and private car-parking have been set up outside subway stations. These measures have effectively solved the problem of the 'last mile'. Finally, Germany has adopted legislation to ensure intercity cooperation in transport. This scenario provides for efficient and convenient transport services to the greatest extent possible.

There are three metropolitan areas in the Pacific City Cluster of Japan, and they are Tokyo–Yokohama, Osaka–Kobe and Nagoya urban areas. These metropolitan areas emerged because of the opening of Japan's Shinkansen, which made it more convenient for the population and capital to flow between metropolitan areas. In 1956, Japan proposed the construction of a 'metropolitan area' with Tokyo as the centre and a radius of 100 kms in the document 'Metropolitan Area Preparation Law'. The Pacific City Cluster of Japan also covers Kanagawa, Saitama, Chiba, Ibaraki and other prefectures. The Japan Pacific Urban Agglomeration adopts a core city-oriented mode. At the same time, it has been continuing the planning goal of multiple cores dispersed. The 23 special districts of Tokyo are the core of the mid-level urban agglomeration, which drives the development of Tokyo's peripheral cities. Ibaraki and several prefectures form the outermost layer of the urban agglomeration. The cities cooperate and develop together. Japan's Pacific City Cluster has established a top–down authority to guarantee the synergistic development between cities. Its experience of coordination comes from the development and implementation of their planning activities. The government coordinates between cities by using unique plans for industrial policy, regional functional division of labour and the natural environment.

The Pacific City Cluster of Japan has a large industrial cluster. Within the urban cluster, the Keihin and Keiyo areas are two major world-class industrial zones,

concentrating major industrial sectors of traditional heavy industry and modern high-end manufacturing. It is home to one-third of Japan's population and contains one-third of its total economic output and 40% of its industrial output. It also has a solid industrial base of about 60 Fortune 500 companies, and the Japan Pacific City Cluster is home to financial, research and development, cultural, and entertainment industries. Therefore, the formation of economic unification in the Keihin and Keiyoha regions will enhance competitiveness. The critical factor in their unification is the unified planning layout and the clear division of functions of each port. They have classified the status and level of ports according to their geographical location and throughput capacity, exploited the resources and advantages of each port in the bay area, encouraged healthy competition within ports and promoted the synergistic development of regional industries. Regarding transportation synergy, the transportation integration of the Pacific City Cluster in Japan is highly rated. The reason is that it has a fast, reliable and safe urban transportation system. The Japan Pacific City Cluster has the largest port cluster and aviation network, and the external transportation for the entire city cluster is mainly by water transport, air transportation and railway. The traffic within the urban agglomeration is primarily by road and railroad, and the passenger capacity of the railroad is 85% of the total number of passengers, which proves that the railroad transportation within the urban agglomeration is well developed. On the basis of the multi-level spatial structure of the Pacific City Cluster in Japan, the intercity railroads and other rail transportation in the city cluster have developed into a multi-level and multi-class integrated transportation network, which plays the role of intercity public transportation in the city cluster. At the same time, the highway construction layout is 'three rings and nine radials', which forms a three-dimensional interactive, integrated transportation network with railway transportation.

In summary, the world-class city clusters developed by different countries according to their development environment with different synergistic development modes. In terms of the city cluster synergistic development mode, China's Yangtze River Delta City Cluster is a mode with the national central city as the core. There are two types of city cluster synergistic development modes in foreign countries, the central city-based mode and the multi-centre synergistic mode. For example, the Northeast Atlantic Coastal City Cluster of the U.S. and the Pacific City Cluster of Japan are based on the central city mode. At the same time, the Rhine–Ruhr City Cluster is a multi-centre synergistic mode. In summary, from both industrial layout and transportation, there are still differences between the regions of China's Yangtze River Delta City Cluster. Currently, the industrial structure optimisation and transportation integration construction of the Yangtze River Delta City Cluster is in the process of further enhancement.

By contrast, urban agglomerations in the U.S., Japan and Germany tend already to have mature spatial structures and mature industrial structures. They concentrate on the advantageous industries of each city within the urban agglomerations, actively participate in global competition and have high economic connectivity within the urban agglomerations. Their transportation infrastructure networks have developed and have a perfect transportation integration system. Their excellent transportation

infrastructure networks provide the basis for economic and social development. Thus, the urban agglomerations in developed countries are at a high level of urbanisation.

The synergistic development experiences of the developing Yangtze River Delta City Cluster and international city cluster have certain implications for other city clusters. In the next section, we take the Hengqin–Guangdong–Macao Deep Cooperation Zone as an example and analyse it. The advantages and difficulties in forming the synergistic development of the Hengqin–Guangdong–Macao Deep Cooperation Zone are discussed in comparison with the regional synergistic development experiences of domestic and foreign cases.

2.3 Hengqin and Macao Synergy: Advantages and Difficulties

In the context of the development and construction of the Guangdong–Hong Kong–Macao GBA, the document 'Outline of the Development Plan of Guangdong–Hong Kong–Macao Greater Bay Area' points out that relying on the advantages of Hong Kong and Macao as free and open economies and Guangdong as the leader of reform, it builds a platform for cooperation and development amongst Guangdong, Hong Kong and Macao. The purpose of building the Hengqin Guangdong–Macao In-Depth Cooperation Zone is to promote the development of the Guangdong–Hong Kong–Macao GBA. The Hengqin Guangdong–Macao In-Depth Cooperation Zone is an elaborate new model, new platform, new demonstration and new highland. This is a major deployment to enrich the practice of 'One Country, Two Systems' (Central Committee of the CPC and the State Council, 2019). In September 2021, the document 'Overall Plan for the Construction of Hengqin Guangdong–Macao Deep Cooperation Zone' issued by the Central Committee of the Communist Party of China and the State Council pointed out that Hengqin is adjacent to Macao and has the inherent advantages of Guangdong–Macao cooperation. It should deepen the cooperation amongst Guangdong, Hong Kong and Macao and promote mutual benefits, common development and progress amongst cities in the Guangdong–Hong Kong–Macao GBA (Central Committee of the CPC and the State Council, 2021). At the same time, this is also the process of coexistence of opportunities and challenges.

From the perspective of China's overall development pattern, China will build a new development pattern during the 14th Five-Year Plan period. From the perspective of China's overall development pattern, a new development pattern will be built during the 14th Five-Year Plan period. The document 'Proposal of the Central Committee of the Communist Party of China on the formulation of the 14th Five-Year Plan for National Economic and Social Development and Vision 2035' mentions maintaining Macao's long-term prosperity and stability and supporting the SAR in consolidating and enhancing its competitiveness. To achieve diversified and sustainable economic development and to help Macao better integrate into the national development pattern (Central Committee of the CPC, 2020). The integration of Macao into

the national development pattern is a significant opportunity to achieve sustainable development. In terms of Macao and Hengqin's strengths, Macao is a crossroads for domestic and international exchanges. It also has the advantages of tourism, technology research and development, multi-culturalism and a Sino–Portuguese intermediary platform. Macao's overall tourism industry is performing well, driven by the gaming tourism industry. Every year, Macao hosts international tourism events, such as the Grand Prix, Macao International Music Festival and other events that attract many international friends and visitors to Macao. With the strong support of the State and the Macao government, Macao has also been able to achieve good results in scientific research and development. Macao already has four State Key Laboratories, and Macao is the only city on the west bank of the Pearl River with State Key Laboratories. In the sixteenth century, Macao was an important stronghold of the Maritime Silk Road and the earliest base for two-way cultural exchange between the East and the West. Moreover, under the influence of historical, cultural, linguistic and human relations factors, Macao has always had traditional and extensive ties with Portuguese-speaking countries. Given this environment, Macao has also been optimising the foundation and conditions of its service platform for economic and trade cooperation with Portuguese-speaking countries. Under the impact of the novel coronavirus pneumonia, the limitations of Macao's development have been exposed more clearly. Regarding problems of having a small space or single industrial structure, it has hindered Macao society from maintaining long-term sustainable growth. Hengqin will play a core engine function in the construction of the entire Guangdong–Hong Kong–Macao GBA, leading and driving. Its role is mainly to support and serve Macao. Hengqin is adjacent to Macao and has spatial advantages as a newly developed area with a land area of approximately 106 km^2. It can effectively alleviate the current situation of high population density in Macao. Combining the two places' advantages and promoting their synergistic development can provide new space for Macao, enrich Macao's industries and enhance the regional competitiveness of the west bank of the Pearl River Estuary.

As the construction of the Hengqin–Guangdong–Macao Deep Cooperation Zone is under 'One Country, Two Systems', two customs zones and two currencies, the difficulties of building the Hengqin–Guangdong–Macao Deep Cooperation Zone under the mechanism of codevelopment, comanagement and sharing cannot be ignored. It must deal with the obstacles brought by the difference between 'two systems'. There are still gaps in the interface between the systems of Macao and Hengqin. The cooperation between Macao and Hengqin has entered into deeper institutional issues, which require a deeper level of breakthrough in the barriers to relevant policies. Compared with world-class city clusters, the sharing mechanism between the two places is not established. For example, how will the results of cooperation be coordinated during the synergistic development of Macao and Hengqin? How will the outcome of Hengqin complement the moderate diversification of Macao's economy? These questions are still in the stage of exploration and research. The development of industrial synergy between Hengqin and Macao has not reached the expectation, and the industrial connection between the two places has been hindered. In industrial planning, Hengqin is set to be a high-technology

and modern service industry with high technical requirements and capital needs, resulting in a high threshold for pre-investment projects. It is difficult for small- and medium-sized enterprises in Macao to join the cooperation zone.

Meanwhile, Macao's tourism industry is an advantage. Nonetheless, it operates separately from Hengqin's tourism industry, and the differences in the tourism industry between the two places are more significant than the fusion. Referring to the experience of industrial synergy development of the city cluster in the case, for Hengqin and Macao to achieve practical complementary mutual assistance and synergy development of industries, the overall mechanism of synergy and cooperation between the two places should be clarified. The two places should jointly study industrial planning and apply industrial policies for synergy between the two places. According to the actual situation of industrial development of the two places, a fine selection of industries to be cultivated. To give full play to the industrial advantages of the two places and to clarify the division of labour and collaboration between the two cities. Let Hengqin and Macao industries experience the effect of complementary resources and adhere to the principle of industrial differentiation, the implementation of industrial dislocation development. Avoid the consequences of industrial homogenisation between the two cities and low-level competition. In addition, the high-quality synergistic development of world-class city clusters is due to the focus on the communication role of a well-developed transportation network. The development of transportation and information industries is an essential condition that contributes to the rapid development of city clusters. The Macao Light Rail Extension Hengqin Transportation Line project is officially underway. It is expected that by 2025 at the earliest, people will be able to reach Macao directly by light rail in Hengqin. Regarding high-speed rail and intercity transportation, Macao will also cooperate in promoting the planning and construction of projects, such as the Guangzhou–Zhuhai (Macao) High-Speed Rail and Nansha–Zhuhai (Zhongshan) Intercity Railroad, which are the critical work plans in Macao's transport planning long-term tasks for 2030.

The integration of transportation between Hengqin and Macao is in its infancy, and solving the 'last mile' of urban transportation in the future is a difficult subject. Nonetheless, it is essential to solving this problem. It can effectively improve the efficiency of transportation services. To achieve synergy and cooperation between Hengqin and Macao, a well-developed transportation network must be built, and Hengqin and Macao need to accelerate the completion of transportation integration.

In a word, the synergistic regional development in this chapter mainly refers to the regional cooperation formed in the form of city clusters. In an era of increasing global connectivity, synergistic regional development is already an essential urban management and planning theme and will see significant progress in the future. On the one hand, synergistic development mechanisms between regions are becoming more complete. On the other hand, cities worldwide strive to become more sustainable and resilient. Thus, the theory and practice of regional synergy provide an essential

opportunity to help understand how systems between regions work together. It can provide better design and governance policies for cities and regions.

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