Spatial research and framework of digital portal technology for urban sustainable development

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Abstract: this paper reviews the evolution of the urban sustainable development theory and Reflections on the current challenges facing the generic use of the sustainable - ity concept in scientific research To meet the impact of enhancing space use EFI - city and spatial quality in the era of urban regeneration, the paper advocate for the integration of space as a critical perspective in sustainability research It develop - ops a technical framework for the spatial expression of economic, social, and envi - ronmental development, with a specific focus on key elements and digital portal The framework aligns spatial sustainability with the spatialization of economic, so - cial, and environmental systems By utilizing comprehensive and fine grained spatial - temporary big data from multiple sources, the paper introduces a multi-dimensional digital portal method, which is applied to Hangzhou and other typical areas in or - der to realize sustainable urban development objectives

Keywords: urban sustainability; Spatialization studies; Digital portals

Theoretical evolution and Reflection on urban sustainable development

In 1987, the World Commission on environment and development issued "our common future", which clearly expounded the concept of sustainable development for the first time, from focusing solely on ecological and environmental protection to easing the opposition between development and environmental protection, and building a global environmental ethics system committed to economic development, social equity and environmental friendliness. In the scholars' research on the concept of sustainable development, the connotation of sustainable development has been constantly evolving, gradually forming three major branches: economic sustainable development, ecological sustainable development and social sustainable development [1-2].

In 1992, the United Nations Conference on environment and development adopted documents such as the Rio Declaration and Agenda 21, which became a milestone for the world to promote the concept of sustainable development. Among them, Agenda 21 puts forward targeted goals and implementation means from the three dimensions of society, economy and environment. For example, it emphasizes population dynamics and sustainability in the social aspect, pays attention to the roles and needs of special groups such as women, children, youth and farmers, meets basic needs and improves the living standards of all people; In the economic aspect, it emphasizes the eradication of poverty, the acceleration of international cooperation and relevant policies for the sustainable development of developing countries, and the creation of a safer and more prosperous future; In the aspect of environment, it emphasizes the conservation and management of resources to promote development and improve the protection and management of ecosystems. Since then, the concept of sustainable development has evolved into dozens of meanings, but scholars have generally formed a consensus that the concept of sustainable development should ensure the sustainability of at least the three fields of economy, society and ecology.

As the core area of the global population, the contradiction between man and nature is the most prominent and has become an important position for the implementation of sustainable development strategy. The concepts of Sus - sustainable cities and urban sustainability were

introduced in

It first appeared in the United Nations Sustainable Cities Project in the early 1990s. Since then, the researchers have used the three basic dimensions of economy, society and environment, absorbed the relevant concepts of economics, sociology and ecology, and continuously expanded the theoretical boundary of urban sustainable development, deriving many concepts and theories. The economic dimension introduces the environmental economics model, analyzes the economic value of natural resources, and derives related concepts such as green consumption; The social dimension uses sociological research methods such as questionnaire, interview and network analysis for reference to explore the optimal path to maintain social equity and improve people's living standards, and form concepts and theories such as livable city and environmental behavior; The environmental dimension absorbs the ecological footprint, habitat index and other research methods in ecology, measures the relationship between urban growth, resource and environmental carrying capacity, and carbon emissions, and puts forward relevant concepts such as resilient city and green city [3].

The concept of urban sustainable development is far more extensive than that of green city, ecological city, livable city and other concepts [4]. The concept of urban sustainable derivative continues to emerge, and interdisciplinary concepts are increasing; Domestic urban sustainability research is relatively lagging behind, but there is also an interdisciplinary trend. Through the retrieval of CNKI in the subject core journals of CAJD with the keyword of "urban sustainable development", a total of

From 1994 to 2023, there were 2831 relevant academic papers and 12129 keywords. Through the clustering analysis of keywords in the paper by CiteSpace software, after excluding the location (Shanghai, city) and non-directional keywords (urbanization, index system), it can be found that relevant keywords are mainly distributed in ecological environment (ecological environment, environment, ecological city, scenic forest), resource utilization (mining city), smart city, low-carbon city, industrial land (tertiary industry), urban transportation Urban renewal and other seven directions (Figure 1), of which the keywords of seven interdisciplinary directions accounted for 62.4%. Based on the time line analysis, it is found that the key words related to sustainability gradually change from "mining and ecology" to

Low carbon, renewal, wisdom" and other directions, and interdisciplinary keywords appear more frequently and account for a larger proportion.

From the perspective of keyword distribution, the research on urban sustainable development seems to be rich in content and comprehensive in field, but the theories used are mostly based on the core theories and technical methods of related disciplines, and the urban ontology theory is relatively lacking; It seems that disciplines are integrated, but there is no unified and comparable bottom research framework and method design. It is difficult to effectively support the planning and construction practice of urban sustainable development only from the three dimensions of society, economy and natural environment. According to the keyword analysis of urban sustainable development, the keywords directly related to urban space are only 24.5%, which is far lower than the interdisciplinary direction. The research on urban sustainable development has the trend of "hollowing out" [5], and the research on urban Ontology

Spatialization" focuses less.

Study on the spatialization of urban sustainable development

2.1 review of research on spatialization of urban sustainable development

In view of the trend of generalization and hollowing out of the concept of urban sustainable research, scholars gradually realize that space is an important carrier for understanding the interaction between human and environment, and the research of urban sustainable development should increase the spatial attribute [6]. Early researchers began to combine spatial theory with sustainability theory. Chang Yong and others [7] disassembled the key elements of economic space, social space and ecological space from the dimensions of quantity, quality and time, focusing on the spatial analysis of urban sustainability. Later, researchers represented by godschalk added livability to the three-dimensional model of sustainable urban economy, society and environment, and built a sustainable pyramid model consisting of four pillars, namely, economic development, social equity, environmental protection and livable city [8]. Based on the theory of urban sustainable development and livable cities, the sustainable pyramid model realizes the return of urban planning discipline to the core object of space [9]. Later, in the study, the indicators of spatial attributes in the evaluation system related to urban sustainable development gradually appeared. Gao Jun and others [10] used big data technology to evaluate the United Nations' sustainable development goals

(SDG) quantitative analysis of city related indicators.

At present, the academic research on the spatial content of urban sustainable development is mainly divided into two aspects (Table 1). On the one hand, it focuses on the sustainability of the attributes of space itself, and studies the impact of different land use efficiency, spatial structure, organization mode, and spatial form on the level of urban sustainable development from the perspectives of urban land use, urban spatial form, and urban design and planning policies; On the other hand, it focuses on the key elements of urban sustainable development in the dimensions of economy, society and environment, studies the sustainability of different functional attribute spaces in the city, and explores the sustainable optimization path of urban space such as production space, cultural space, residential space, leisure space, service space and green space. However, the current research on the sustainability of space is mostly based on the dismantling of the SDG goals of the United Nations, which should deal with the identification of the current development problems and key elements of urban development in China. The research data are still lacking in granularity and comparability; Sustainable spatial research is not systematic, and there are relatively more researches from the dimension of spatial justice, especially residential space and service space, and less attention from other dimensions.

2.2 technical framework for space-based, economic, social and environmental sustainable development

The research framework of sustainable development has gone through the embryonic stage of focusing on economic construction and taking into account the sustainability of society and natural environment in the early stage of theory establishment, to the inclusive development stage of emphasizing the unity of economic growth, social development and environmental protection. At present, in order to systematically deal with the problem of urban sustainable development, it is necessary to take urban space as the carrier of sustainable research, and establish the spatial research framework of urban sustainable development combined with the spatial research of economy, society and environment. On the one hand, space is the pillar and background of urban

sustainable development. The research on the spatialization of urban sustainable development needs to return to the space carrier itself and find the direction of its sustainable development research. On the other hand, the improvement of the sustainable level of urban economy, society and environment not only needs the support of the allocation of spatial resources, but also will bring feedback to the urban spatial construction and affect the sustainable development level of urban space. The research on the spatialization of urban sustainable development needs to clarify the interactive relationship between space and sustainable development in the dimensions of economy, society and environment, and clarify the technical idea of Spatialization of economy, society and environment.

Therefore, the research on the spatialization of urban sustainable development needs to do the following: first, mining the spatial attributes of economy, society and environment, clarifying the spatialization focus of three dimensions, and carrying out spatialization research in different dimensions; The second is to study the sustainability of space itself based on the inherent attributes of urban space. Finally, the technical framework of "space as the pillar, economic, social and environmental sustainable development" will be formed. See Figure 2. 2.3 key elements of spatial research and digital portrait Technology

Under the technical framework of economic, social and environmental sustainable development with space as the pillar, the focus of urban sustainable spatialization research is to identify the key elements of the current spatial sustainable development and the spatialization of economic, social and environmental dimensions, and at the same time, with the help of big data technology, build the digital portrait technology of each dimension [28]. Compared with the sustainable development of urban space, the digital portraits of urban economy, society and environment lack clear spatial objects, so it is necessary to give priority to the spatial expression of the three dimensions. On this basis, the three dimensions of economy, society and environment can be similar to the spatial dimension, clarify the focus of key space, and then select the key elements of sustainable development spatialization to complete the digital portrait.

Therefore, this study defines the digital portrait technology framework of "spatial expression - focus - key elements". First, according to the different focus of sustainable development in different stages of urban development, this paper analyzes the core demands of China's current urban sustainable development, and identifies the spatial focus of economic, social and environmental dimensions. Secondly, according to the sub dimensional Research on the relevance of sustainable development, the focus of each dimension in the Chinese context is condensed. Starting from the identification of the core issues of the economic, social and environmental dimensions, the key elements from multiple perspectives are selected to improve the spatial efficiency and quality. Finally, the introduction of multi-source spatio-temporal big data with high coverage and fine granularity, through a series of digital portraits, forms a spatial digital portrait from economic, social and environmental urban sustainable development to urban spatial ontology.

3. Spatial research and digital portraits of economic, social and environmental dimensions

3.1 economic sustainable spatialization research and digital portrait application

3.1.1 extraction of key elements of economic sustainable Spatialization

Production space is the basis of urban economic activities, and it is also the focus of spatial

research on urban economic sustainability. On the one hand, production space needs to adjust the inefficient and extensive mode of production through efficient space utilization and production factors; On the other hand, we need to cultivate innovation space, promote the reorganization of intangible factors such as knowledge capital, human capital and system, and promote the division of labor and cooperation among production factors. Therefore, this paper takes the production space as the main object of economic sustainable spatialization research, and focuses on the cultivation of innovation ecology, the level of cooperation between industries, the intensive level of production space and the attraction to talents [29].

The research on the spatialization of economic sustainability focuses on four key elements, namely, the degree of innovation agglomeration, the degree of industrial relevance, the degree of spatial efficiency, and the attractiveness of employment. With the help of multi-source data, such as the number of headquarters branches, the performance of industrial land, and the number of college graduates, a digital portrait of production space is formed. Among them, the innovation agglomeration degree emphasizes the agglomeration degree of enterprises, institutions, talents and other innovation subjects, and uses the number of high-tech enterprises, scientific research institutes, universities, large scientific devices, national laboratories and other data for standardized weighted analysis; The industrial correlation degree emphasizes the interrelationship between manufacturing enterprises, and uses new data such as the number of headquarters branches and the number of supplier purchase contracts for standardized weighted analysis; The spatial benefit degree emphasizes the land use performance of production space, and carries out standardized weighted analysis based on the data such as the average tax per mu of industrial land and the plot ratio of industrial land; Employment attraction emphasizes the ability of cities to attract talents. Standardized weighted analysis can be carried out by using data such as the employment preference of graduates, the number of college graduates, the increment of permanent population, the number of young people, and the number of highly educated people.

3.1.2 digital portrait application of economic sustainability and Spatialization

The digital portrait of sustainable spatialization of urban economy focuses on the three key elements of innovation agglomeration, spatial efficiency and employment attraction. The digital portrait is constructed through 10 key indicators, so as to screen the industrial space with high level of innovation agglomeration and low efficiency, and evaluate the spatial distribution characteristics. Taking Hangzhou as an example, based on the analysis of the degree of agglomeration of innovation elements such as colleges and universities, incubators, and large scientific installations, the digital portrait identifies three mature innovation areas, including the area around Zhejiang University, the future science and Technology City, and Binjiang, as well as three innovation areas, including the city center, Xiasha, and Qingshan Lake, which are still in the growth stage (Figure 3). The above six innovation areas gather 61% of the city's high-tech production and service enterprises, 52% of scientific research institutions, 46% of highly educated talents and 43% of young people. At the same time, the low performance industrial land in different locations was screened based on the average output value of 50000, 80000 and 100000 yuan per mu, and the low utilization industrial land with a plot ratio of less than 0.8 was superimposed, so as to identify 166 km2 of low efficiency industrial spatial agglomeration areas, such as the north of Gongshu, the south of Xiaoshan, the Linkong area and the east of Qiantang River. Through the identification of innovation factor agglomeration space and inefficient industry space, we can accurately locate the key areas and potential areas of industrial sustainable

development in Hangzhou, so as to guide the centralized delivery of strategies and policies.
Based on the analysis of two key indicators superimposed with the degree of industrial relevance, the digital portrait of urban economic sustainable spatialization can be further expanded to realize the overall evaluation and sub dimensional comparison of the economic sustainable level of different cities, especially by using the index comparison of sub dimension to observe the long and short boards of each city. For example, Hangzhou ranks high in innovation competitiveness by virtue of the annual increase of 270000 permanent residents and the attractiveness of university graduates ranking second. However, due to the lack of basic innovation facilities, Hangzhou does not have an advantage in the level of innovation resource agglomeration; With three national laboratories and eight large scientific devices, Hefei is in the lead in terms of basic innovation facilities. The attractiveness of graduates ranked fourth has a certain advantage in innovation competition, but its innovation cooperation degree is far less than that of Hangzhou and Nanjing.

3.2 social sustainable spatialization research and digital portrait application

3.2.1 extraction of key elements of social sustainable Spatialization

Living space is the main object of the research on the spatialization of social sustainable development. With the change of population structure and urbanization stage, the focus of living space has gradually shifted from "yes" to "good". It is necessary to improve the livability, industry and mobility of urban residents to meet the needs of diverse groups. Therefore, the supply of space and facilities that match the needs of diverse populations for residence, employment and travel is the focus of social sustainable spatialization research.
Therefore, the digital portrait of social sustainable spatialization should first pay attention to the differentiated needs of people of different ages, especially the elderly, the young and the young, and analyze the supply of public service facilities matching the age structure; Secondly, it is necessary to focus on the employment situation and analyze the spatial distribution characteristics of urban employment [30]; Thirdly, we need to pay attention to the travel situation of urban residents and analyze the characteristics of urban commuter traffic. Finally, the spatial research of social sustainability extracts three key elements, namely, livable level, employable level and walkable level. Among them: livable level is based on the census or label data based on mobile location data (LBS) to calculate the proportion of children, youth, middle-aged and elderly

The coverage rate of basic education ①, services for the elderly ②, health management ③, recreational and sports activities ④ and commercial services ⑤ and other facilities are measured for communities with different age structures; Based on LBS commuting data or mobile signaling data, the employability level identifies the distribution of employment space, compares it with the regional permanent population, and analyzes the adequacy of employment supply in the region; The feasible level is also based on LBS commuting data or mobile signaling data to measure the daily commuting distance of urban residents, and finally carry out overlay analysis to establish a sustainable spatial digital portrait of society.

3.2.2 social sustainable spatialization of digital portrait application

Social sustainable digital portraits based on livable level, occupational level and mobility level can accurately show the coupling degree between people and space and facilities in the city. According to the static population distribution, the supply level of precise public service facilities for children, youth and the elderly is analyzed. In view of the dynamic population flow, this paper focuses on

the analysis of the job housing balance level and average commuting distance in different regions, and judges the coupling degree of urban functional layout and population distribution. Taking Hangzhou as an example (Figure 4), from the digital portrait depicting the livable level, it can be seen that in areas with a high concentration of elderly population, such as Shangcheng district and Gongshu District, the coverage rate of community level elderly care facilities is less than 70%; Binjiang and Yuhang areas 4-

The number of children aged 6 and pupils aged 7-12 are relatively large. Further targeted at the areas where the old and the small are concentrated, such as Binjiang and Yuhang in Hangzhou, where children are concentrated but the coverage rate of kindergarten service radius is less than 45%, and the coverage rate of primary school service radius is less than 50%, the supply of facilities suitable for the young and aging needs to be optimized in combination with livable portraits. It can be seen from the digital portrait depicting the level suitable for employment that the ratio of job to residence in the old urban area and Yuhang group is

0.53-0.60, which is the area of job housing balance; The ratio of employment to housing in Jiangnan City is as high as 0.61, which is an employment advantage area; The job residence ratio of six clusters, including Yipeng, Pingyao, Linping, Guali, Liangzhu and Linping, is lower than 0.50, belonging to weak employment areas. It can be seen from the digital portrait depicting the level suitable for walking that the long-distance commuting of more than 15 km accounts for less than 10% in the two types of areas, namely, the areas with balanced employment and housing and the areas with employment advantages in Hangzhou, and the commuting distance is relatively reasonable; In the peripheral areas with weak employment, long-distance commuting of more than 15 km accounts for more than 20%.

Digital portraits can provide optimization ideas for the functional layout and facility supply of urban social sustainable development, such as paying attention to the elderly and the small population, and realizing the balanced supply of urban living and employment space. On the basis of the sustainable spatial digital portraits of a single city, we can also establish the sustainable spatial digital portraits of a series of cities, and measure the sustainable development level of different cities by comparing the livable level, the business level and the travel level.

3.3 spatialization research and digital portrait application of environmental sustainability

3.3.1 extraction of key elements of environmental sustainability Spatialization

Green space is the key content of environmental sustainability. To realize the sustainable development of the urban environment, on the one hand, it is necessary to ensure that the total amount of green space is sufficient to provide the ecological services, air purification, climate regulation and other functions required by the city. On the other hand, it is necessary to continuously optimize the green space pattern with patches and continuous network corridors as the carrier, and improve its coverage, continuity and functional composite level, so as to ensure the organic continuity of the urban habitat and the quality of life of the surrounding residents. Therefore, the total amount, layout and quality of green space are the focus of environmental sustainable spatialization research.

Through remote sensing data, statistical data and spatial analysis data to establish a digital portrait of environmental sustainability. The total green space index is analyzed by using the per capita park green space area, normalized difference vegetation index (NDVI) and other data. The layout of green space uses the park coverage ⑥ index to analyze the accessibility and evenness of park

green space for local residents; Use the per capita park security ⑦ index to further increase the analysis granularity to analyze the supply level of park area in different regions. The service quality of green space is based on the number of biological species and population density in the green space, and the indicators of biodiversity and population vitality are evaluated respectively.

3.3.2 digital portrait application of environmental sustainability and Spatialization

An environmentally sustainable digital portrait that integrates the total amount, layout and quality of green space can accurately measure the distribution and service level of green space within a city. Take Hangzhou as an example (Figure 5): in terms of the total amount of green space, digital portraits identify the area of various green spaces, and it is measured that the per capita park green space area in Hangzhou is 13.74 m2, close to the national average (14 m2). In terms of spatial layout, the coverage rate of parks with a radius of 500 m in the urban area of Hangzhou is 81.81%, which is good, but the continuity of park green space in Peripheral Districts and counties is insufficient, and the coverage rate of service radius is generally less than 80%, which is a phenomenon of "high in the urban area and low in the periphery". At the same time, Hangzhou's per capita park security degree reached 63.64%, and the proportion of areas with per capita park supply of more than 5 M2 reached 63.64%, ranking third among the 12 megacities, but the proportion of areas with per capita park supply of more than 20 m2 was insufficient

28.28%, indicating that the number of comprehensive parks with more complete facilities and larger area in Hangzhou is insufficient. In terms of the quality of green space, digital portraits reflect that the vitality of people in Hangzhou's green space is still the highest around the West Lake, Xixi and other traditional scenic spots. There is a lack of certain commercial and public service facilities around riverside green space, such as riverside green space and Xiasha green space, and the vitality of people is relatively low.

Based on the analysis of environmental sustainable digital portraits, we can identify areas with insufficient green space coverage, and judge the service quality of existing green space, so as to put forward ideas for environmental sustainable optimization, such as increasing diversified green space, improving green space coverage and accessibility. On the basis of the digital image of the sustainable spatial environment of a single city, the total amount, layout and quality of green space between cities can also be compared.

4 digital portraits of sustainable development in spatial dimensions

4.1 extraction of key elements of sustainable development in spatial dimension

Another important content of the research on the spatialization of sustainable development is the research on the sustainable development of space itself. On the one hand, it is necessary to maintain appropriate development intensity for the sustainability of land resource utilization and the realization of intensive and efficient use and orderly release of land; On the other hand, it is the embodiment of livability, ensuring well-designed living environment space, avoiding overcrowded living environment, and meeting health and hygiene requirements. The sustainability of urban form has become a broad consensus of scholars on the sustainable development of urban space [31]. Common spatial form indicators include three basic indicators: intensity, density and height. In addition, they also include compactness, dispersion and fractal dimension [32]. In order to eliminate the strong correlation between indicators and avoid too many contradictions between indicators, this paper starts from the basic attributes of spatial form, selects three key elements, height, density and intensity, which are directly related to the control of urban spatial form, to

establish the digital portrait of urban spatial form, and calculates the average height, density and intensity of the neighborhood by using land survey data and surveying and mapping modeling data, Form digital portraits of spatial dimensions.

4.2 digital image application of urban spatial form based on height density intensity

The digital image of spatial form can accurately depict the urban spatial form with the neighborhood as the unit, analyze the distribution characteristics of the current urban spatial form, and further compare it with the spatial form based on planning prediction and ideal intensity zoning, so as to identify the possible problem risks of urban spatial form, so as to carry out planning response.

Based on the average building height, average building density, average development intensity, land area, building area, building base area and other six indicators, the current situation of urban spatial form can be formed into a digital portrait. The K - means clustering algorithm analysis of the six indicators can divide the urban internal neighborhoods into various spatial forms, such as high intensity, high density and high height, medium intensity, high density and high height. Different cities usually contain 4-6 types of typical neighborhood spatial forms. Taking Hangzhou as an example, four types of typical neighborhood spatial patterns were identified by digital portraits (Fig. 6). Among them, the high-intensity, medium density and High-height neighborhoods are basically concentrated within the belt expressway, mostly high-rise building clusters in Wulin Square, Qianjiang New City, Riverside central area and Zijingang town. The average development intensity of the neighborhoods is 5.0-6.0, the average building density is 30% -32%, and the average building height is more than 48 M; Medium intensity, high density and medium height plots are arranged along the old city single core. Most of them are lakeside commercial blocks that best represent the traditional spatial gene of Hangzhou. The average development intensity of the neighborhood is 1.8-2.0, and the average building density

40% -45%, with an average building height of 27-48 m; The low-intensity, high-density and low-altitude plots are hollow layout along the peripheral industrial clusters, mostly the plants and campuses of Xiasha Economic Development Zone, Zijingang Zhejiang University and xiaoshanqiao west area. The average development intensity of the neighborhood is 1.2-1.5, the average building density is 36% -40%, and the average building height is 12-27 M; Low intensity, low density and low height plots are scattered, mostly scattered plots near the mountains, Jianqiao airport and around Xiaoshan township industry. The average development intensity of the neighborhood is less than 0.5, the average building density is less than 18%, and the average building height is usually less than 12 M.

On the basis of the current digital image, the expected image of the future urban spatial form can be further formed by using the height, density and strength control data of the approved control plan, and the risk points in the future urban spatial form control can be identified by comparing with the current image. Taking Hangzhou as an example, through the comparison between the current situation and the expected digital portraits, it is found that the planned plot ratio will still be significantly improved compared with the current situation, and the average plot ratio within the city circle will increase from

The proportion of plots with medium and high intensity increased from 31% to 60%. In particular, the construction intensity in the north of the city and the south of Xiaoshan will be greatly increased, which will bring challenges to the protection of the historical and cultural features of

the city. In addition, the distribution of neighborhood area with different development intensity can be compared with the intensity distribution of an ideal city, and the reasonable degree of overall spatial development of different cities can be judged. Based on the author's previous research, the high density intensity of neighborhoods and the key elements of sustainable development (economic benefits, livable level, space quality, etc.) show an inverted U-shaped relationship. We should advocate more "olive shaped" urban intensity distribution dominated by medium development intensity [33]. Taking Hangzhou as an example, the overall strength distribution curve in the belt expressway is close to the "olive shape". The area of plots with medium strength (plot ratio of 1.0-2.5) accounts for the largest proportion, which exceeds 40% of the total construction area in the belt expressway. However, compared with the ideal distribution, the proportion of plots with medium strength is still low, and the proportion of plots with low strength (plot ratio of less than 1.0) is relatively high, It shows that there are still a certain number of neighborhoods with low development intensity in the city, and the space utilization efficiency can be moderately improved.

Through the fine depiction of the urban spatial form by digital portraits, we can achieve the guidance of zoning height, intensity and density control, and put forward more practical optimization strategies for the density control of the old city, the height control of key areas such as waterfront and surrounding mountains, and the intensity control of other general areas. Based on the digital portrait and analysis of a single city, the digital portrait of urban spatial morphology can also be used to compare the differences of overall spatial morphology characteristics between cities by analyzing the average building height, average construction density and average development intensity for different cities, as shown in Table 2.

5 Summary and Outlook

This paper reviews the evolution of the theory of urban sustainable development, and puts forward that space as an important carrier of sustainable development should be included in the dimension of urban sustainable researchThe technical framework of "space as the pillar, economic social environmental sustainable development

(Figure 7), trying to solve the problem of generalization of the current concept of urban sustainability research, and taking space as an important chassis of sustainability research.

As China's urban development has entered a new stage of "stock based renewal", improving spatial efficiency and spatial quality has become the main line to promote urban spatial development. Through structural optimization, composite utilization, and enhancing the intensity to improve the efficiency of space utilization, the spatial competitiveness of the city can be improved; The improvement of space quality is directly related to the "re upgrading" of citizens' well-being, and is of great significance to the transformation of citizens' life from "yes" to "good". Therefore, this spatialization study of urban sustainable development explores the multi-scale digital portrait technology, and proposes the precise implementation methods to improve the spatial efficiency and spatial quality, which has important local significance and era value to support the high-quality development of cities in China.

Of course, at present, the systematic research on the spatialization of urban sustainable development has just begun. In the future, with the further enrichment of technical means, the scientific nature of the research still has a lot of room to improve. The key elements of spatial

research can be further increased. For example, facing important issues such as climate change, digital portrait technology can further increase the elements and indicators of total carbon emissions, carbon emissions structure and other aspects [34]; The scale of spatial research can also be further refined. This paper still focuses on the urban scale, and the community scale is less involved. In the future, with the further improvement of data accuracy, the research object can be further extended to the block and community scale.