


Research Article

Study on the Spatial Structure and City Form Construction of River Valley-Type Cities in the Context of Artificial Intelligence—A Case Study of Northwest China

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This paper uses Northwest China as an example to present an in-depth study and analysis of river valley cities' spatial structure and city form in the context of artificial intelligence. The paper focuses on alleviating the “core-edge” spatial structure locking effect, achieving the “industry-space” scale effect and cooperation, solving the problem of endogenous dynamics to promote regional and urban development, and promoting various main functional areas based on the derivation discussion and spatial growth model selection. The study focuses on the exploration of paths to alleviate the “core-edge” spatial structure's locking effect, realize the scale effect and cooperation ability of “industry-space,” solve the problem of endogenous power to promote regional and urban development, and promote the new urbanization path of different main functional areas based on the discussion and spatial growth mode selection. We measure the evolution characteristics of industrial and spatial elements and the level of intersystem synergistic development to address the spatial growth and industrial transformation of the northwest region urban agglomeration in the special development period, discover the defects of the northwest China urban agglomeration's spatial growth, and select the appropriate spatial growth model in the foreseeable spatial and temporal scope. The new city spatial form in the northwest region, which strengthens regional characteristics, is the spatial form combined with the new city plan form in two dimensions. This paper investigates the relationship between regional characteristics and urban spatial carriers by developing spatial planning design ideas and methods that reflect the regional characteristics of new cities in the northwest region, in order to improve the spatial quality of new cities in the northwest region and their sense of belonging to the city, provide a new spatial expansion idea for small cities in river valleys in the Qinling Mountains of southern Shaanxi, and enrich the spatial quality of new cities in the northwest region.

1. Introduction

As a complex of central cities with core radiation and close relations with surrounding cities, urban agglomerations are of great significance in leading the multipolar development of the region and are the key engine of the new urbanization strategy and an important part of the territorial spatial planning system. The construction of urban agglomerations is of great significance to China in realizing collaborative urban development and top-level design of territorial spatial planning [1]. The spatial qualities derived from industrial development are reflected in the aggregation of the same or

different types of industries at the spatial level, and from the overview of the current development of the world economy, the spatial agglomeration is more obvious in both developing and developed countries. Led by the reform and opening, the industrial characteristics of the Yangtze River Delta, the Pearl River Delta, and other coastal areas as industrial agglomerations are becoming increasingly obvious, and the space also shows an increasing development trend of agglomeration, while the industrial agglomeration of the northwest region urban agglomeration is still at the stage of marginal development [2]. It shows that people's occupation of the ecological environment is increasingly

than that, and the ecological service capacity will not be conducive to the sustainable development of the urban ecological environment overall. The industrial transformation has an important role in promoting economic development, has a driving role in realizing economies of scale and external economic optimization, and is also conducive to deepening the social division of labor and extending the existing industrial chain, which has been more abundantly supported by economic development and practice in various countries [3]. As the key engine and important carrier for the development of urban agglomerations, the interaction between industry and space will affect the growth and synergistic development of urban agglomerations. Chinese city clusters are unevenly developed and mostly immature, especially such cross-provincial administrative region city clusters as the northwest China City Cluster, which generally suffer from weak cooperation mechanisms, different development paths, difficulties in industrial collaboration, and the supremacy of local interests, which greatly restrict the healthy development of city clusters [4]. The industrial system and the spatial system are highly unified in two-dimensional attributes in space and time, and the integration, support, and constraint with each other contribute to the coordination of the two in structure and function during the continuous evolution of each system. The goal of the research is to reveal the intrinsic mechanism of industry and the spatial system, to lay a theoretical foundation with universal significance, and to guide the measurement of synergistic development of the two systems in the northwest China urban agglomeration, as well as the selection of future growth patterns and development directions. The study reveals the spatial growth pattern of the agglomeration under its influence, based on the evolution characteristics of the industrial and spatial elements of the northwest China urban agglomeration and the measurement of the level of synergistic development, with the goal of visualizing the development state of each city in the agglomeration under the synergistic influence of industry and space and providing directional and feasible guidance for the expansion of new space.

This thesis study stands on the height of ecology, takes the northwest region as the research object, takes the urban and rural space of the northwest region city as the empirical research territory, considers and examines the relationship between economy, society, resources, and environment of the urban and rural development of the northwest region city in an integrated manner, and uses the multidisciplinary theoretical methods such as ecology, landscape science, sociology, geography, and planning to explore the theoretical and technical methods applicable to the urban and rural spatial development of the northwest region. Through systematic evaluation and analysis, we will clarify the development objectives, spatial layout methods, spatial structure patterns, and multilevel planning strategies for urban and rural spaces in Northwest China, provide planning theories and methods for transforming the development mode, improving development quality, and restoring the ecological environment in Northwest China under ecological orientation, and at the same time combine with the current spatial planning of the country [5]. Interpretative analysis has a

clear future direction, and its unique conceptual mapping characteristics have opened an optimistic outlook for the inheritance and creation of urban material spatial forms. It also provides a theoretical and methodological basis for promoting spatial planning reform, developing a scientific “double evaluation” system, exploring the spatial planning of Northwest cities, and making decisions on urban and rural development patterns. Human activities as the main system, such as cities, villages, and regions, are a social, economic, and natural environment constituted by the interconnection, mutual constraints of the composite system. Human beings have long been self-centered and focused too much on human social and economic development and economic benefits, while neglecting the functions and values of the natural environment for human services, so that they face a series of ecological and environmental problems such as resource decline, land degradation, environmental pollution, and water shortage in the process of development, thus seriously restricting the sustainable development of the system and prompting people to begin to pay more attention to the application of ecological principles and methods to study the strategies and realization paths for the harmonious development of human society and the environment.

Scholars at home and abroad have discussed and studied ecological planning, ecological safety, ecological footprint, composite ecosystem, ecological city construction, ecological environment carrying capacity, and other topics in this context. This paper is based on a review of relevant research literature from both domestic and international sources, as well as the mainstream trend in recent years of research on the relationship between ecological environmental protection and urban and rural development, utilizing theories and methods from ecology, geography, urban and rural planning, and other multidisciplinary disciplines to systematically summarize relevant research on urban and rural spatial development under ecological orientation. The ecologically oriented research framework for urban and rural spatial development patterns and planning strategies has not only strengthened and reformed the research perspective on urban and rural spatial development patterns but also conducted systematic research on urban and rural spatial planning strategies from “laws” to “principles,” which has improved to some extent. It has a theoretical significance and has improved the theoretical system of urban-rural spatial research.

2. Current Status of Research

Urban historical public space is the core of the spirit of urban places and individual characteristics, and the preservation of urban historical public space can continue the most important spatial culture of the city [6]. In a sense, urban public space is the core of the city, but also the city life itself, and urban historical public space is the best narrator of the city’s regional culture. However, changes in life and economic patterns, construction patterns, and social structures have led to increasingly obvious contradictions between citizens’ demand for public space in historic urban areas and

their current situation [7]. There is also a contradiction between the need for a sense of belonging and the loss of the characteristics of urban public space. With the spread of science and technology and various design ideas around the world, urban spaces are becoming homogeneous, and people are beginning to consciously reflect on the problem of the lack of regional identity [8], continuing the characteristics of the traditional Shangnan context, incorporating dynamic social and economic characteristics into the expression of regional characteristics, and using the connotation factors of these regional characteristics such as regional culture and natural environment to fit the urban space. In the field of architecture, Kenneth Frampton, a British architect, proposed in 1985 the concept of “urban space.” In the field of architecture, British architect Kenneth Frampton put forward the idea of “critical regionalism” in which he believed that “regionalism should be re-examined in the modernist environment to find out the regional cultural vein with local characteristics, not only the integration of climate, culture, and technology.” In the field of landscape planning, Japanese landscape architect Sasaki believed that the creation of the landscape environment should reflect the art of symbiosis between man and nature and that the landscape environment should be practical [9]. At the same time, research related to the safety pattern of natural elements and cities was also hot in this period, and in the field of architectural design, emphasis was placed on reducing energy consumption and reaching the goal of being friendly to the environment through the climate-adapted design of buildings and local sections of the city [10].

A review of relevant studies on regional characteristics mainly focuses on urban planning, urban design, and Shangnan’s regional characteristics, and both urban planning and urban design research on regional characteristics have undergone. The study of regional characteristics in urban planning and urban design has undergone a transformation and balance between the ideas of “natural characteristics” and “social and cultural connotations” [11]. It is easy to find from the research history of regional characteristics at home and abroad that regional characteristics are the essential factors constituting the spatial characteristics of a city, are the result of the joint action of nature, humanities, and social economy of the city, and are the dynamic development process of constantly replacing old regional characteristics and generating new ones with the development of the times and social economy [12]. The research on regional characteristics in urban planning is mostly concerned with the study of regional and city form, which shows that regional characteristics are important factors affecting urban function, structure, and morphology, but there is less exploration on the inner relationship between regional characteristics and urban function, structure, and morphology [13]. The industrial and spatial cooperation of northwest China urban agglomeration studied in this paper is the process of optimal combination and coordinated development of industrial system elements and spatial system elements; the industrial system contains elements of industrial height, industrial scale, open innovation, green governance, etc., and the spatial system contains elements of social economy, construction land,

support system, resource potential, etc. The main purpose is to analyze the endogenous mechanism of intermingling, response, and coordination among the elements in the industrial and spatial systems, as well as the coupling state and dynamic process of optimal allocation, cooperation, and symbiotic evolution among the systems, with the support of the basic characteristics of the synergistic relationship such as wholeness, interaction, dynamics, and feedback, to reflect the spatial pattern characteristics and growth mechanism of the urban agglomeration and provide a rational basis for the judgment of the spatial growth mode of the Hachang urban agglomeration. This will provide a rationalization basis for the judgment of the spatial growth pattern of the Hachang urban agglomeration.

It is to implement the regional cultural connotation of the new city into the specific physical space form, and it is also the practical stage of the construction of the new city’s spatial characteristics. The space of urban agglomerations is the carrier of the activities of cities in the region, and the interdependence and role of socioeconomic object elements in the territorial scope of urban agglomerations, the interconnection of such elements is the fundamental motive of forming the spatial organization of urban agglomerations, and the spatial organization structure of urban agglomerations is the basic model and development skeleton of the spatial growth of urban agglomerations. The spatial organization structure of urban agglomerations is the basic model and development skeleton of urban agglomerations.

3. Analysis of Spatial Structure and Urban Form Construction of River Valley-Type Cities in Northwest China in the Context of Artificial Intelligence

3.1. Spatial Structure Construction of River Valley-Type Cities in Northwest China with Artificial Intelligence. The core of urban agglomerations is formed by the core first city, which is combined with the urban group development zone to cultivate the core of urban agglomerations, and the urban distribution zone and hinterland area are formed at the periphery. The improved gravity model is used to analyze urban spatial synergistic associations, and the three-level urban system of large regions, regions, and localities is used as the system division method for China’s urban agglomerations. The gradual agglomeration and diffusion of urban agglomerations from cities to metropolitan regions and metropolitan areas, as well as the further development of metropolitan areas, result in the formation of city clusters or metropolitan belts. The study of the internal structure and development law of urban agglomerations is based on the above research, which examines the spatial organization structure and spatial evolution process of urban agglomerations [14]. The spatial factor-oriented research examines the spatial growth dynamics of urban agglomerations through the lens of social behavior, with a focus on the interpretation and analysis of urban spatial growth through the lenses of subjectivity, intention, value standard, and environmental

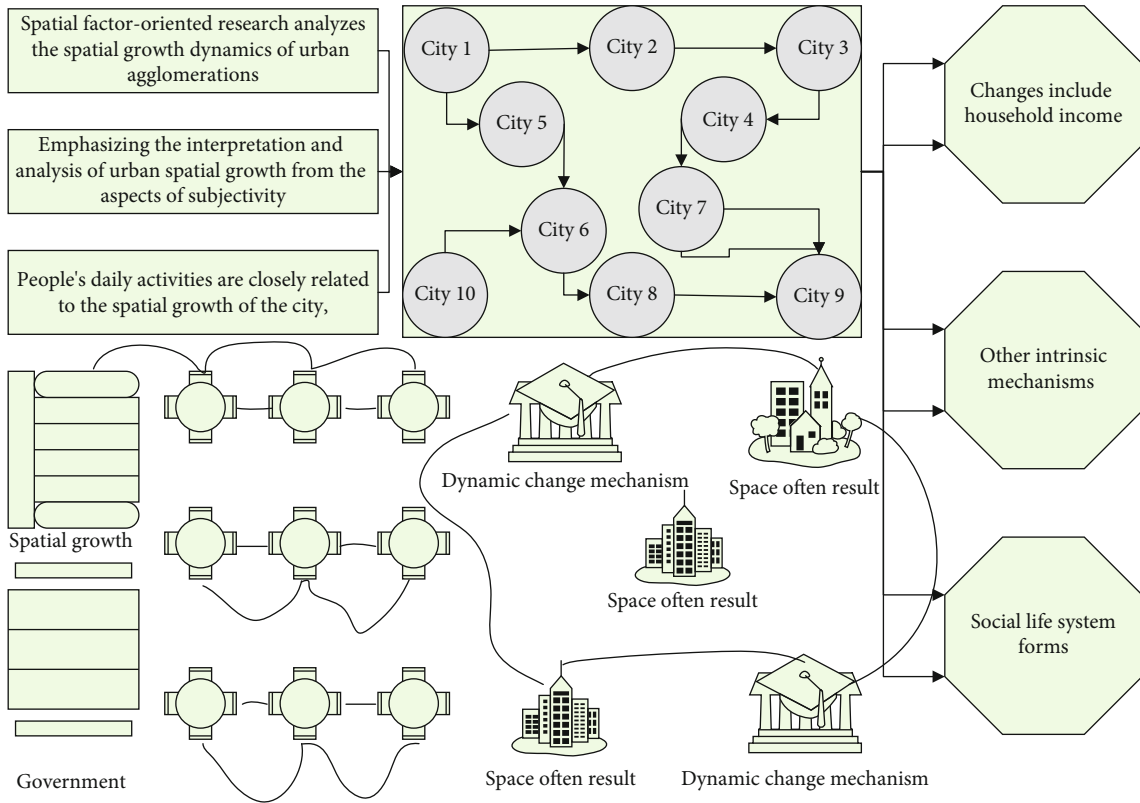


FIGURE 1: Framework for building the spatial structure of river valley-type cities.

perception. The findings show that people’s daily activities are closely linked to the city’s spatial growth, with household income, social class, and other intrinsic mechanisms serving as major influencing factors [15]. The separation of land use and social life systems creates a dynamic change mechanism, while the differentiation of lifestyles and people’s choices of space frequently leads to government regulation mechanisms. Spatial growth is the result of these mechanisms acting in concert, and space users play a key role in the competition and negotiation of urban space. Furthermore, the intrinsic driving force of spatial growth of urban agglomerations is also the result of changing social distance gradient, and this measure of social value reveals the consideration of social factors in spatial location selection from a different perspective, as well as illustrating that for spatial growth; social factors are to some extent manifested as a direct influence, whereas economic factors are, relatively speaking, an indirect influence, reflecting the deep problem. Economic, social, land resource, and other factors all have a driving effect on the spatial growth of urban clusters, according to related research, as shown in Figure 1.

On the one hand, the self-configuration role is the limitation of natural conditions, which can maintain the ecological environment that depends on it, and on the other hand, the market role can bring higher efficiency by following the market law. When the spatial structure of a town does not conform to the natural conditions and market development, problems such as destruction of the natural environment and low efficiency of the town will arise, and then it needs

to be guided and adjusted by the structure [16]. When the spatial structure of the town conforms to the law of self-construction, the structure can be further guided by the law of planning. It is through this process of internal and external dynamic action that the town system can form a good relationship with the outside and maintain a virtuous cycle within the system. The spatial structure of the town can be studied using the landscape pattern index in three research categories: first, the built-up area and a certain area around it as the spatial amplitude of the landscape, the urban area as a homogeneous territory, and the built-up area is seen as a whole, a patch [17]. It is the endogenous driving force of the spatial structure of artificial and natural mutual harmony, and it also reflects the urban context and landscape value of the mountain space characteristics. This is mainly for the study of the external morphology of the town. Secondly, the spatial territorial extent of the built-up area is taken as the spatial magnitude of the landscape, the urban landscape is regarded as a heterogeneous territory, and the built-up area is composed of different land use patches. This one mainly addresses land use structure analysis. Third, the spatial extent of green space as a landscape, the green landscape as a heterogeneous territory, and all kinds of green space are a patch. This one is mainly for the analysis of the green space network.

From different perspectives, these two types of indicators reflect the characteristics of the external contours of the town’s spatial structure. The lower the compactness of a town of a similar size, the more dispersed the layout, and

TABLE 1: Judgment matrix of sensitivity evaluation factors.

Sensitivity factor	Geomorphological factors	Plant and animal factors	Water resource factor	Historical and cultural factors	Urban construction factor
Geomorphological factors	5	2	1	5	1
Plant and animal factors	1	4	2	1	3
Water resource factor	3	2	5	2	7
Strategic reserve factor	4	8	1	3	2
Historical and cultural factors	5	2	1	3	4
Urban construction factor	5	1	5	2	1

thus, the more functionally dispersed it is; the longer it lengthens, the greater the aspect ratio of the site and the narrower the development of the site, and the more dispersed the town's functions are to some extent. Agglomeration of functions can respond to the efficiency of spatial structure, i.e., economic efficiency, while it can also close distances, make service facilities more accessible in spatial geography, improve service efficiency of public service implementation, and thus respond to social benefits. At the same scale, compact town forms have less contact with the natural environment, have a lower impact on the natural environment, and have less interference from human activities, reflecting environmental benefits. As a result, this type of indicator can primarily be used to assess economic benefits, with some social and natural benefits thrown in for good measure. Overall, it reflects the state of the road network. Its indicators are not just for determining whether or not the structure is efficient. The higher the proportion of road land and the area of land for roads and transport facilities per capita, under certain conditions (the same scale, the same road and land organization, and the same natural environmental conditions), the higher the road network's road efficiency and service area. However, the lower the percentage of roads that are in good working order, the more land is saved.

After selecting and determining six ecological sensitivity analysis evaluation factors of topography and landscape, flora and fauna, water resources, strategic resources, history and culture, and urban construction, a comparison matrix is used to determine the weights according to the importance of each factor to the ecological sensitivity of the city. It is the endogenous driving force of the spatial structure of artificial and natural mutual harmony, and it also reflects the urban context and landscape value of the mountain space characteristics. The usual methods for determining the weights of single evaluation factors are the Telfer method, regression analysis method, hierarchical analysis method, and expert opinion method. In this study, we mainly compare every single factor into two by constructing a judgment matrix to form a comparison matrix, as shown in Table 1, and use the product method (square root method) to calculate the maximum characteristic root and the corresponding characteristic vector.

Further, the consistency metrics CI and CR are calculated to ensure the consistency of the matrix.

$$CI = \lambda^2 \max + \frac{1}{n}, \quad (1)$$

$$CR = \frac{CI}{RCI}.$$

To be able to respond to the strengths and weaknesses of the evaluation results objectively and comprehensively and to summarize the characteristics and problems of the ecological sensitivity of the municipality, determining the evaluation criteria and the grade classification is the key to the realization of the evaluation. In this study, based on the reference to the relevant bidding standards and consultation with relevant experts, the ranking of the evaluation criteria is clarified for each factor. The overall is divided into five levels according to the sensitivity, which is very high, high sensitivity, medium sensitivity, low sensitivity, and nonsensitivity.

$$EC = N \sum_{j=1}^n (A_j \times R_j \times Y_j^2). \quad (2)$$

When the ecological carrying capacity is smaller than the ecological footprint, the ecology is in a deficit state, which means that people's encroachment on the ecological environment is more than the service capacity of the ecology, which will not be conducive to the sustainable development of the urban ecological environment overall. The development of urban agglomerations is uneven, and most of them are not yet mature. Interprovincial administrative region urban agglomerations such as the Harbin-Changzhou urban agglomeration generally have problems such as weak coordination mechanisms, different development paths, difficulties in industrial collaboration, and supremacy of local interests. The healthy development of urban agglomerations is greatly restricted. When the ecological carrying capacity is greater than the ecological footprint, it means that the demand for human activities on the ecological environment is smaller and still within the ecological tolerance range, and maintaining this state is

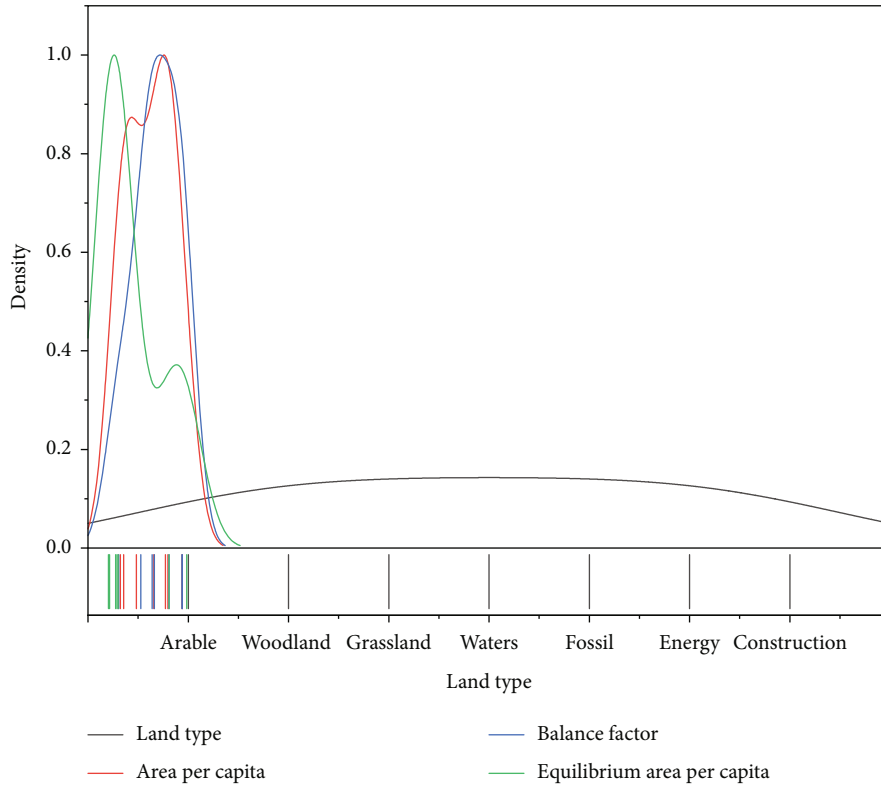


FIGURE 2: Ecological footprint of river valley cities in northwest China from IIT.

conducive to the sustainable development of the city. When the ecological carrying capacity is equal to the ecological footprint, it means that the ecological supply is equal to the human demand, and the ecology is in a state of balanced development [18]. According to the method and index described in the previous article, the ecological carrying capacity evaluation index is not calculated, when the index is ≥ 85 , it is good ecological carrying capacity; when the index is in the range of 70-85, it is good ecological carrying capacity; when the index is in the range of 55-70, it is average ecological carrying capacity; when the index is in the range of 40-55, it is poor ecological carrying capacity; when the index is ≤ 40 , it is poor ecological carrying capacity. It is poor ecological carrying capacity, as shown in Figure 2.

In terms of the composition of the ecological footprint supply, arable land, forests, and built-up land are the mainstays of the Northwest Regional Municipality's ecological footprint supply, while watershed and pastureland supply capacity is limited. In terms of ecological footprint supply and demand, productive land is only sufficient for built-up land and forest, indicating that the land required for urban construction can be met in terms of quantity, and the advantage of forest resources is more prominent. However, the supply of arable and fossil fuel land is insufficient to meet demand, posing a threat to forest and built-up land; the actual available area of built-up land may not be as optimistic due to constraints such as topography, development costs, and ecological suitability, and scientific evidence must be strengthened.

3.2. Analysis of Urban Form Construction. In typological theory and research, the Creel brothers, the backbone of neorationalism, use typology as a tool to interpret traditional towns and cities and propose a theory of urban form for modern cities and historic urban locations. From Creel's theories, we can learn to understand the city from a clear spatial-block-building hierarchy, emphasize the functional complex to realize the diversity of urban life, and focus on the continuation of the city's cultural lineage in terms of spatial structure and building type. Their theories and practices are not only for new urban areas but also for the analysis and reconstruction of traditional and historical urban spaces. Their theory and practice are of great significance not only for new urban areas but also for the analysis and reconstruction of the space of traditional and historical urban areas. It is aimed at visually showing the development status of cities in the cluster under the influence of industry and space coordination and providing direction and feasibility guidance for the expansion and development of new spaces in the Harbin-Changsha city cluster.

It is noteworthy that the objectivity of interpretive analysis and the subjectivity of research strategy coexist at the same time, and this characteristic of thinking makes it possible to link phenomenal analysis and design operation. Interpretive analysis has a distinct future orientation, and its unique conceptual mapping characteristics open optimistic prospects for the transmission and creation of urban physical space forms. The importance of morphological interpretation for urban design is also recognized in its connection and difference with detailed planning [19]. Detailed

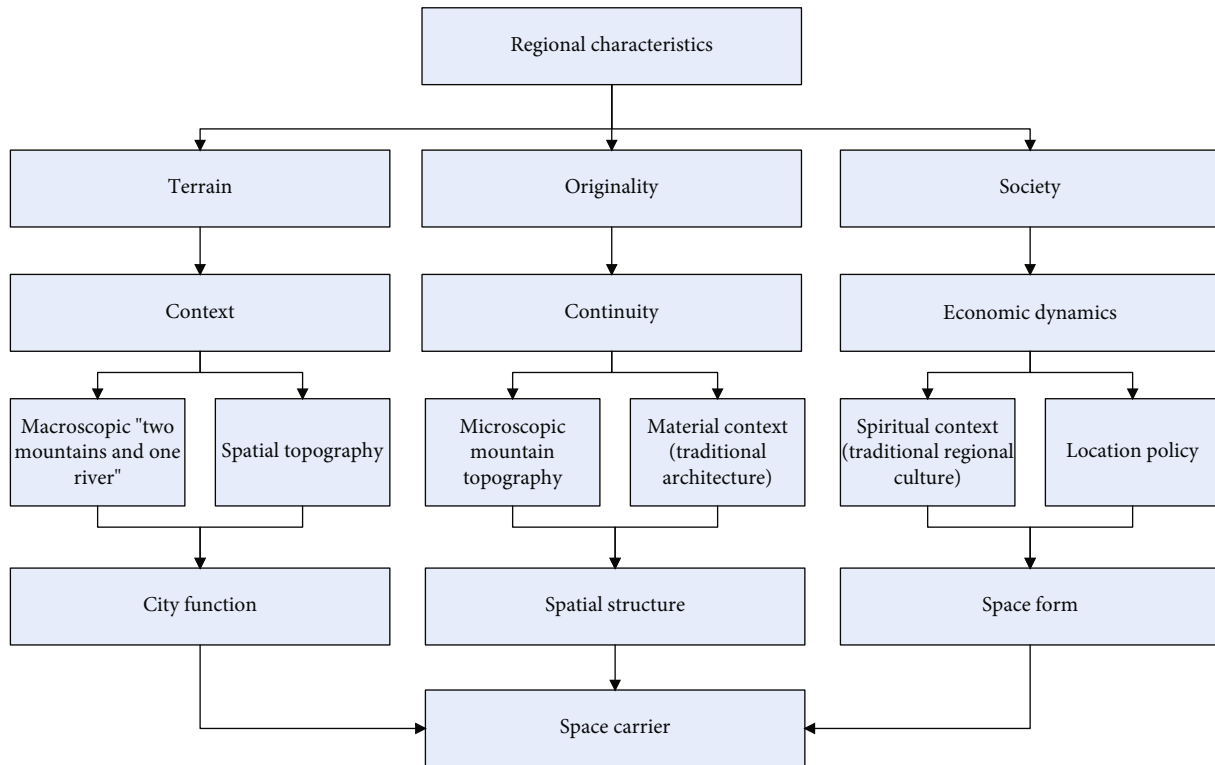


FIGURE 3: Relationship between geographic features and urban spatial carriers.

planning focuses on the shift from expert or zoning plans to more specific control of economic and technical indicators and municipal engineering plans. The corresponding level of urban design is more focused on complementing the spatial environment in terms of its pleasant qualities and socio-cultural symbols and recognizable features. Since urban design is based on the elaboration of spatial forms, it inevitably brings both rational and sensual characteristics, so the logic and creativity of the generation of material space forms become a key part of the design process, and this logic and creativity is based on the interpretive understanding of the forms in the first place. The judgment of the genesis of city form is not a substitute for the design of morphology; the former is a morphological criticism based on rational analysis, while the latter is a comprehensive creative act. Morphological interpretation is based on the morphological description, which transforms morphological description into a morphogenetic diagrammatic mechanism, and is in essence a morphogenetic hypothesis oriented to formal strategies in the design process. In general, investigation, analysis and planning, and design constitute a trilogy of urban design procedures, so morphological interpretation is the key operational point to move from analysis and evaluation to integrated design, as shown in Figure 3.

The emergence of urban personality is inextricably linked to regional culture, which is a key factor in the emergence, construction, and evolution of urban characteristics. The construction of new city spatial characteristics focuses on the spatial and temporal expression of the new city under the spatial review of Northwest China city location, highlighting and strengthening the native topographic back-

ground characteristics, continuing traditional Northwest China cultural characteristics, and integrating dynamic socioeconomic characteristics into the expression of regional characteristics. The creation and development of urban characteristic space that reflects regional characteristics are primarily reflected in three aspects: urban function derived from regional cultural characteristics, urban structure highlighting natural characteristics and socioeconomic development characteristics, and spatial form reinforcing regional characteristics [20]. Natural topography is a prerequisite for the regional characteristics of new cities and plays a decisive and dominant role in urban space. We should preserve the new city's natural landscape pattern, which is the best heirloom of the city's regional characteristics. With the changing stage of Northwest China's urban development, the new city's position in the city and the role it plays change.

The planning and design at the level of strategic review should analyze the urban development and the imagery of urban characteristics of Shangnan and should start with the study of the location relationship, which should be linked to the general plan of Shangnan, and based on clarifying the relationship between the eastern new city and the urban development of Northwest China and the status and role of the eastern new city in the city of Northwest China, the design of the spatial characteristics of the eastern new city in terms of cultural connotation excavation, artistic expression, and spatiotemporal reconstruction should be launched. The design of the spatial elements of the eastern new city is based on the cultural connotation, artistic expression, and spatial and temporal reconstruction. The analysis

and research of the new city location relationship should focus on grasping the relevance and hierarchy of the location space, especially taking the specificity of the main space of the location as the starting point. Landscape, sociology, geography, planning, and other multidisciplinary theoretical methods explore theories and technical methods applicable to urban and rural spatial development in Northwest China and build a multiscale, multilevel, and multidimensional ecological evaluation system. The key to planning and design is to combine the analysis of location relationship with the core issues in the spatial design of the eastern new city, to guide the overall spatial planning and urban design of the eastern new city. The spatial design guided by the overall goal established at the strategic review level is the implementation stage of the strategic review level, which is the implementation of the regional cultural connotation of the new city into the concrete material spatial form, and the practical stage of the construction of the spatial characteristics of the new city. The refinement, reconstruction, and spatial and temporal expression of the regional cultural elements are the necessary way to realize the overall characteristic imagery of the new city's regional culture, through the sublimation and interpretation of the city's traditional regional culture into modern urban functions, and the coupling of the urban structure with the native natural environment, to realize the overall urban imagery characteristics to be expressed in the plan, as shown in Figure 4.

The refinement and reconstruction of regional characteristics are based on the discovery and understanding of many elements such as local traditional culture, natural geographical features, and historical and cultural connotations of the city, and through the screening and comparison, general integration, and abstract interpretation of these elements, they are simplified and reconstructed into spatial carriers utilizing spatial design, so that the regional characteristics of the city can be perceived and experienced by people in the urban space [21]. The spatial characteristics of the city can be perceived and experienced in the urban space. At the same time, urban planning and modern urban design are used to realize the distinctive urban context of the new city in two-dimensional and three-dimensional spatial dimensions.

The spatial form of the city is a complex system, and the root of its complex nature is inevitably traced back to the spatial prototype of its initial formation—the natural topography, which is manifested in the diversity, comprehensiveness, and continuity of the topography. From the beginning of its formation, the natural topography is a continuous and complex system, and there is no simple landform of a certain form in the world, and one kind of topography may contain other kinds of topographic features. People living in different geographical environments have different histories, cultures, religions, customs, and behaviors, which are often reflected in people's demands for urban functions. As a result, in the development process, facing a series of ecological and environmental problems such as resource decline, land degradation, environmental pollution, and water shortage, which severely restrict the sustainable development of the

system, it also prompts people to begin to pay more attention to the principles of applied ecology. The unique regional characteristics of Dongbu New Town are inevitably related to the overall development of Northwest China City in which it is located. In different development stages of Northwest China City, people's needs also change with the changes in the natural and human environment and urban development stages, and this change is precisely reflected in the changes in urban functions. Therefore, the urban function is the connotation of regional characteristics, and the new city space that meets the needs of Northwest China urban development, and regional characteristics is the new city function derived from regional characteristics. Residential buildings are the most frequently used spaces, so they require good lighting and ventilation and avoid north-sloping sites as much as possible in the site layout. Due to the diverse combination of residential building forms, it can cope with diverse terrain changes and can be built in areas with complex elevation changes and steep slopes that have better adaptability to the slope of the terrain and therefore better adaptability to the level of the site.

4. Analysis of Results

4.1. Results of the Spatial Structure of River Valley Cities. The new city is in the general environment of Northwest China, a typical river valley-type strip city, but due to its location in the over-real space area of Shangnan and its natural environment characteristics, the mountainous spatial characteristics of the new city in the east are reflected in the river valley-type city, which is typical in the river valley city. The focus of this section is to reflect the mountainous spatial characteristics of the new city, to strengthen the mountainous characteristics of the new city using urban design, and to shape the image of the new city that reveals mountains and water and is rich and three-dimensional. By drawing on and summarizing the examples of valley cities, the author believes that the biggest difference between plain cities and valley cities in urban space design lies in the influence of topography and terrain in valley cities, which makes the relationship between artificial and natural closer, which is one of the important characteristics of valley cities. The spatial pattern of "mountain in the city, city in the mountain" is a unique characteristic of East New Town. When we consider the design of its spatial pattern, we should give full play to the advantages of the river valley city in the mutual understanding between the artificial and natural environment and, more importantly, strengthen the unique mountain spatial characteristics of the new city through the interactive relationship between artificial and natural. Research on spatial factors dominates the analysis of the spatial growth dynamics of urban agglomerations from the perspective of social behavior, emphasizing the interpretation and analysis of urban spatial growth in terms of subjectivity, intentions, value standards, and environmental perception. The compatibility and symbiosis between manufactured and nature are the result of the interaction between the human ability to transform the terrain and the innate power of nature, which is the endogenous driving force of the spatial

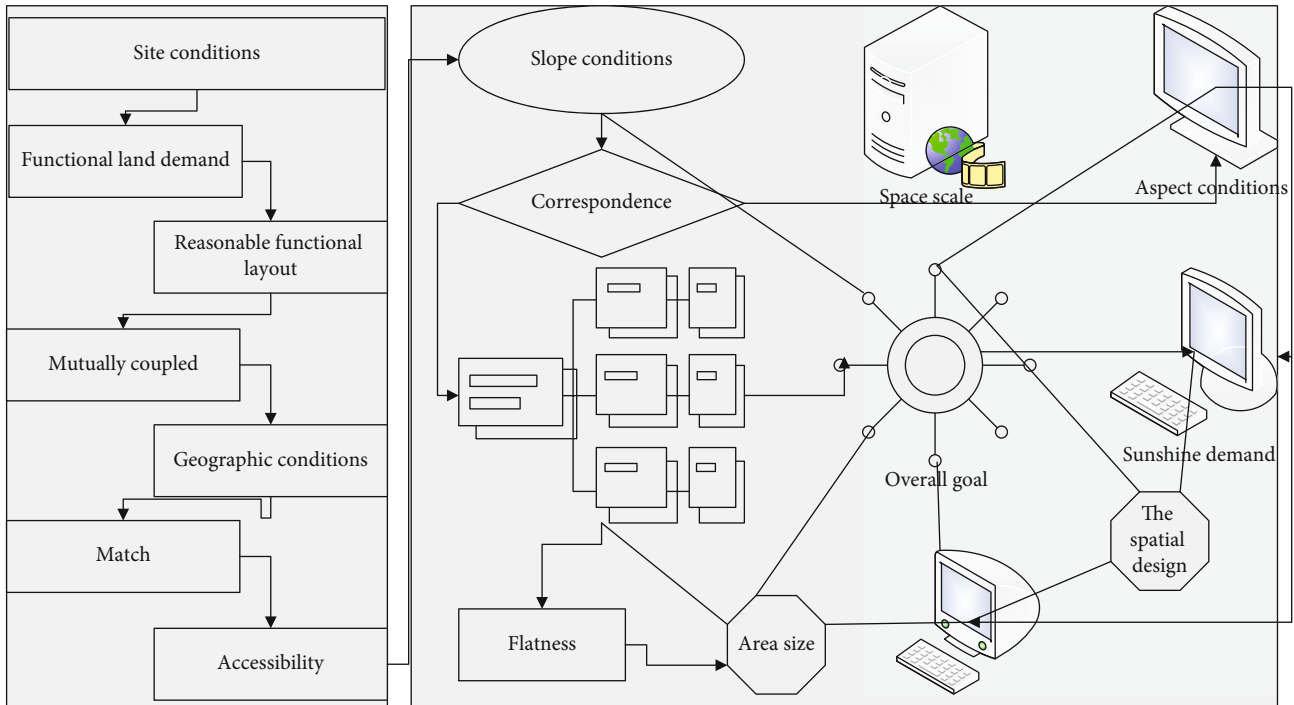


FIGURE 4: Coupling of functional needs and site land conditions.

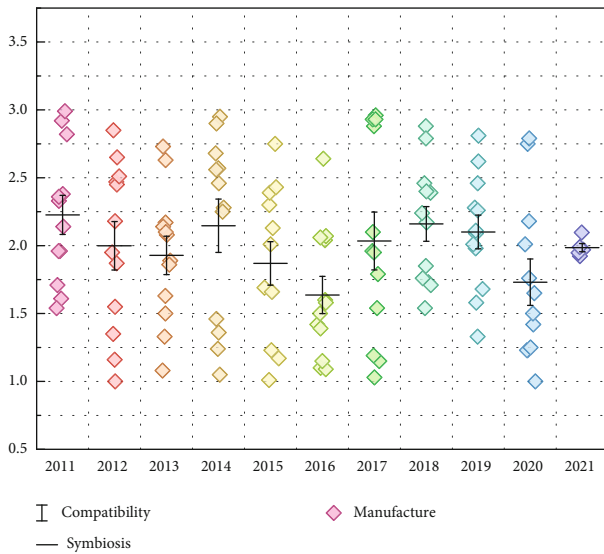


FIGURE 5: Spatial structure.

structure of manufactured and natural and reflects the urban culture and landscape value of mountainous spatial characteristics as shown in Figure 5.

In river valley cities, the organic and harmonious relationship between artificial and nature generally shows the relationship between artificial space and natural space in spatial form interspersed with each other, which contrasts with the plain city landscape natural space and urban built-up area, so the dull and clear-cut form. Therefore, in the spatial form design, the planning should make good use of the organic and dynamic natural advantages of the landscape environment, combined with the artificial envi-

ronment, to create a lively and vivid spatial combination of human and natural symbiosis, reflecting the organic beauty of the river valley city, as shown in Figure 6.

The organic spirituality of natural and artificial environments in space needs to carry out the mutual grinding of the two environmental boundaries to form the mutual coupling of spatial boundaries. From the study of the actual case of river valley-type city construction in the previous article, a good river valley city form rarely has a moderate and angular urban boundary in the zone where the artificial and natural environment is articulated. Therefore, the artificial and natural coupled boundary should try to coordinate the urban boundary with the natural boundary in a homeopathic way and thus strengthen the city image of regional characteristics, and at the same time, in the urban development and construction, the urban development cost can be greatly reduced. It is through this internal and external dynamic process that the urban system can form a good relationship with the outside and maintain a virtuous circle within the system. Therefore, the planning and design of modern river valley cities should fully draw on the experience of traditional mountain city construction, adhering to the use of mountain boundaries to shape the contour boundaries of the artificial built environment and appropriately drawing mountains into the city to enrich the urban landscape. Both inside and outside the city, the spatial and land use organization should follow the boundaries of natural mountains and water bodies.

At the macro level, the urban built environment should follow the direction of mountainous terrain to judge the direction of urban spatial expansion, which is the reason most valley-type cities develop with the direction of valleys and rivers. The coupling of manufactured and nature is to

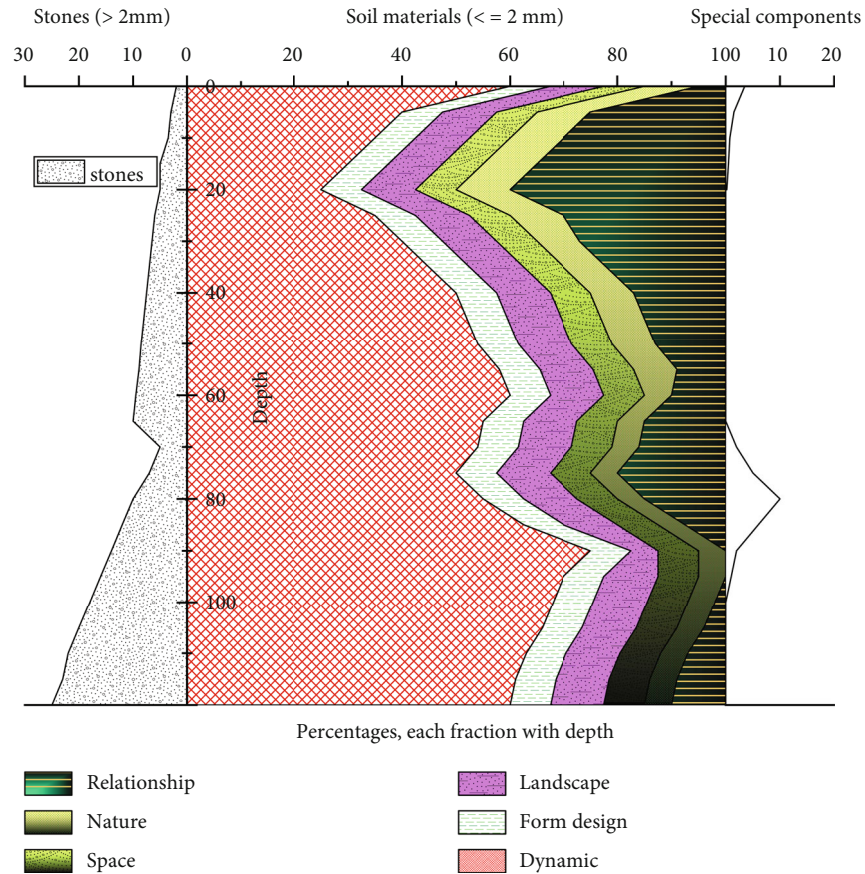


FIGURE 6: Comparison of the relationship between manufactured and natural opposites and symbiosis.

try to achieve parallelism with the mountain contours when planning and designing the artificial space boundaries.

4.2. Results of City Form Construction. The highest value decreases significantly, while the remaining boundary values change slightly, indicating that, while the capacity of the spatial units with the best level of outward orientation has weakened, their advantage over other spatial units remains relatively obvious. When the boundary values of each level remain constant, the number of high-level spatial units increases while the number of medium-level and lower-level spatial units decreases, indicating that the level of industrial outwardness of the northwest China urban agglomeration has increased more noticeably and the gap between medium-level and lower-level spatial units has narrowed. The cluster's contribution of industrial outward orientation is primarily made up of a few high-level spatial units, with a low contribution of more than 3/5 spatial units. As shown in Table 2, the spatial units of high and higher levels cluster, the spatial units of medium level gradually move closer to the area of high level, and the spatial units of low and lower levels are crowded out to the north and east of the cluster.

According to the ecological footprint, i.e., the ecological carrying capacity analysis, the ecological environment of the Northwest Regional Municipality has been in an extremely insecure state for a long time, indicating that in the long-term urban development process, human claims

on nature have exceeded the supply capacity of ecological nature itself, and ecological economic development is in an unsustainable state, which will seriously affect or even restrict the development of the city in the long run. The per capita ecological deficit of municipalities in the northwest is high, and the socioeconomic activities of municipalities have far exceeded their ecological carrying capacity. The demand for fossil energy and arable land accounts for the absolute bulk of the city's ecological footprint demand, indicating that energy consumption accounts for the absolute dominance of the city's ecological resource consumption and is the most important factor contributing to the high ecological deficit of the Northwest Regional Municipality. There is a certain degree of overload of arable land in the NWT city, and attention should be paid to the protection of existing arable land and other agricultural land to prevent agricultural production from regressing and endangering the security of the local food supply.

The analysis of road network structure in this paper focuses on four aspects: total volume, service situation, road network form, and road network topology characteristics. The analysis of the total volume uses land use ratio and per capita indicators to determine the characteristics and problems of its total volume. The service situation is studied mainly through road density and efficiency. The road network topological characteristics are analyzed mainly through the spatial sentence method to analyze the accessibility and

TABLE 2: Upper loop block control guidelines.

Name	Protect the building	Newly built between protected buildings	Features
Land use nature	Boundary values	Lower-level	5
Volume rate	Change significantly	Spatial units decrease	4
Protection design guidelines	High level	Front part of the protected	7
Building height	Medium levels	Protected building must be preserved	9

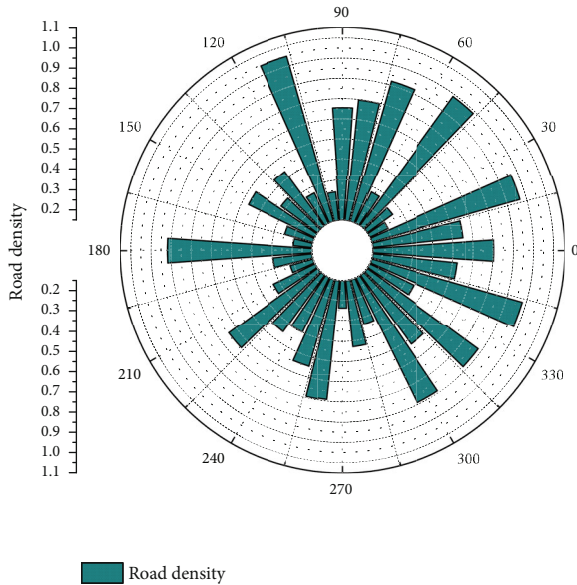


FIGURE 7: Correlation analysis of urban compactness with road density and road efficiency.

identifiability of the road network. The analysis of road density in river valley-type towns reveals a correlation between the road density index and the compactness index of the town, which in turn is related to the town development pattern. There is also a correlation between road efficiency and the compactness of towns. The correlation analysis of town compactness and road density by SPSS shows that there is a high correlation between the two with a correlation index of 0.841. The correlation analysis of town compactness and road efficiency by SPSS shows that there is some correlation between the two with a correlation index of 0.732. The correlation dispersion plot is shown in Figure 7. Service facilities are made more accessible in space and geography, the service efficiency of public service implementation is improved, and thus social benefits reflect. The compact towns of the same scale have few contact areas with the natural environment, have relatively little impact on the natural environment, and have less interference from human activities on nature, reflecting environmental benefits. The road network density of towns is relatively low when the compactness of towns is large, i.e., when towns are relatively compactly developed. And in terms of road service efficiency, we found that the road network service efficiency of towns with higher compactness is higher to a certain extent, i.e., towns with compact development have longer roads created per unit area to a certain extent and long roads that can be used to serve the land to create more street frontage.

As a result, in the 13 case towns, road network density is relatively high in the relatively scattered ribbon and cluster development patterns, but relatively low in the tract development pattern. For example, the road density in Zhongdu's strip town is 14.25 km/km^2 , while in Jinchuan's slice town, it is only 7.88 km/km^2 . To provide service to all areas, roads need to provide service to a large and efficient area. As a result, the relatively dispersed development of ribbon and cluster towns will necessitate more roads than compact track towns with similar built-up areas, resulting in a high road network density.

5. Conclusion

Using road land share and per capita indicators, road density, and road efficiency indicators, the topology of the road network form was analyzed using the spatial sentence method. Overall, there is a higher road share, a higher road density, and a lower road efficiency. Low-grade towns have mostly free-form road networks, whereas high-grade towns have mixed or square grid road networks. Sheet towns have a square grid, grouped towns have a mixed grid, and strip towns have a free-form grid. Ring and square grid road network forms are more accessible and recognizable than mixed and free-form road networks in terms of accessibility and recognition. Small-scale incremental public space remediation plans must be adopted as part of a macro plan for overall conservation if the plan is to address critical issues. By turning the whole into zero, microscale incremental remediation can reduce the financial and management pressures of urban construction while also creating the conditions for ongoing public space maintenance, testing, and correction of correct practice. The microprogressive improvement of public space is a strategy for turning the whole into zero, then from zero to whole, and realizing the development of urban public space in a focused and step-by-step manner through catalytic implantation, point-by-point, and network evolution. Urban agglomerations are gradually becoming the primary unit of international competition, and their role and status are growing. The development of urban agglomerations is relatively lagging, and there is an urgent need to guide the spatial growth pattern through comprehensive research, as they are an important jigsaw puzzle of China's urban agglomerations and an important area for the revitalization of old industrial bases in Northeast China.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

- [1] K. E. Schaefer, J. Oh, D. Aksaray, and D. Barber, "Integrating context into artificial intelligence: research from the robotics collaborative technology alliance," *AI Magazine*, vol. 40, no. 3, pp. 28–40, 2019.
- [2] Y. Song, Y. Long, P. Wu, and X. Wang, "Are all cities with similar urban form or not? Redefining cities with ubiquitous points of interest and evaluating them with indicators at city and block levels in China," *International Journal of Geographical Information Science*, vol. 32, no. 12, pp. 2447–2476, 2018.
- [3] G. Mazurek and K. Małagocka, "Perception of privacy and data protection in the context of the development of artificial intelligence," *Journal of Management Analytics*, vol. 6, no. 4, pp. 344–364, 2019.
- [4] J. Dibble, A. Prelorendjos, O. Romice et al., "On the origin of spaces: Morphometric foundations of urban form evolution," *Environment and Planning B: Urban Analytics and City Science*, vol. 46, no. 4, pp. 707–730, 2019.
- [5] E. F. Villaronga, P. Kieseberg, and T. Li, "Humans forget, machines remember: artificial intelligence and the right to be forgotten," *Computer Law and Security Review*, vol. 34, no. 2, pp. 304–313, 2018.
- [6] L. Hu, J. Yang, T. Yang, Y. Tu, and J. Zhu, "Urban spatial structure and travel in China," *Journal of Planning Literature*, vol. 35, no. 1, pp. 6–24, 2020.
- [7] G. D'Acquisto, "On conflicts between ethical and logical principles in artificial intelligence," *AI & SOCIETY*, vol. 35, no. 4, pp. 895–900, 2020.
- [8] U. Köse, "Are we safe enough in the future of artificial intelligence? A discussion on machine ethics and artificial intelligence safety," *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, vol. 9, no. 2, pp. 184–197, 2018.
- [9] Y. Liu, J. Wu, D. Yu, and Q. Ma, "The relationship between urban form and air pollution depends on seasonality and city size," *Environmental Science and Pollution Research*, vol. 25, no. 16, pp. 15554–15567, 2018.
- [10] M. R. Kim, K. Y. Jung, and J. Noh, "Examining development of collaborative artificial intelligence in the context of classroom instruction," *East Asian Mathematical Journal*, vol. 35, no. 4, pp. 509–528, 2019.
- [11] W. J. González, "From intelligence to rationality of minds and machines in contemporary society: the sciences of design and the role of information," *Minds and Machines*, vol. 27, no. 3, pp. 397–424, 2017.
- [12] A. Krehl and S. Siedentop, "Towards a typology of urban centers and subcenters—evidence from German city regions," *Urban Geography*, vol. 40, no. 1, pp. 58–82, 2019.
- [13] A. Araldi and G. Fusco, "From the street to the metropolitan region: Pedestrian perspective in urban fabric analysis," *Environment and Planning B: Urban Analytics and City Science*, vol. 46, no. 7, pp. 1243–1263, 2019.
- [14] S. Hamidi and A. Zandiatashbar, "Does urban form matter for innovation productivity? A national multi-level study of the association between neighbourhood innovation capacity and urban sprawl," *Urban Studies*, vol. 56, no. 8, pp. 1576–1594, 2019.
- [15] S. L. Farhan, I. A. Jasim, and S. K. Al-Mamoori, "The transformation of the city of Najaf, Iraq: analysis, reality and future prospects," *Journal of Urban Regeneration & Renewal*, vol. 13, no. 2, pp. 160–171, 2019.
- [16] L. Snidaro, J. G. Herrero, J. Llinas, and E. Blasch, "Recent trends in context exploitation for information fusion and AI," *AI Magazine*, vol. 40, no. 3, pp. 14–27, 2019.
- [17] H. M. Mazraeh and M. Pazhouhanfar, "Effects of vernacular architecture structure on urban sustainability case study: Qeshm Island, Iran," *Frontiers of Architectural Research*, vol. 7, no. 1, pp. 11–24, 2018.
- [18] J. Zhou, Y. Zhou, B. Wang, and J. Zang, "Human-cyber-physical systems (HCPSs) in the context of new-generation intelligent manufacturing," *Engineering*, vol. 5, no. 4, pp. 624–636, 2019.
- [19] F. Jotterand and C. Bosco, "Keeping the "human in the loop" in the age of artificial intelligence," *Science and Engineering Ethics*, vol. 26, no. 5, pp. 2455–2460, 2020.
- [20] Z. Su, G. Togay, and A. M. Côté, "Artificial intelligence: a destructive and yet creative force in the skilled labour market," *Human Resource Development International*, vol. 24, no. 3, pp. 341–352, 2021.
- [21] L. Pettersen, "Why artificial intelligence will not outsmart complex knowledge work," *Work, Employment and Society*, vol. 33, no. 6, pp. 1058–1067, 2019.