Research on Virtual Reality Technology Aided Shared Urban Design

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Abstract: Virtual reality (VR) technology integrates various technologies such as simulation, multimedia, network, computer graphics, human-machine interface, and sensing. It is a very challenging frontier subject and research field at present and in the future. With the gradual maturity of VR technology and development, VR technology has been applied to many fields. The purpose of this article is to explore the specific application effects of virtual reality technology in assisting shared urban design. This article analyzes the advantages and disadvantages of virtual reality technology in the application of shared urban design by searching literature, questionnaires and field investigations. Data statistics and scoring were carried out from several aspects such as design efficiency, urban planning management efficiency, reducing resource waste and improving design rationality. The research results show that virtual reality technology-assisted shared urban design can increase design efficiency by 35.2%, planning management efficiency by 24.8%, comprehensive waste of manpower and material resources by 21.2%, and overall planning and design rationality and design quality by 29.5%. Therefore, it can be seen that virtual reality technology to assist shared urban design is feasible and will surely become a new development trend in the field of urban planning and design.

Keywords: Virtual Reality Technology, Shared City, Aided Design, City Planning

1. Introduction

Virtual reality (VR technology) integrates simulation, multimedia, network, computer graphic human-machine interface, sensing and other technologies. VR technology can be said to be a very challenging frontier and research field now and in the future. VR technology based on relevant science and biological technology can be generated within the scope of actual environments such as vision, hearing, touch, etc. It has a very similar digital environment, user interaction with necessary equipment and digital objects that affect each other's environment, as well as actual bring feeling and experience to the environment.

At present, the rapid development of information technology and its wide application in various fields are promoting the level of urban informatization [1]. In the field of shared city planning and management, virtual reality technology and 3D simulation systems are gradually introduced. Shared city planning and construction have become the pioneers of the innovative technological revolution, and the concept of urban development is more advanced [2]. In the past, two-dimensional GIS data processing technology was mainly used to plan and manage urban space. Therefore, virtual reality technology may become the mainstream technology of urban planning and management in the future [3]. Urban simulation system and virtual reality technology can digitize and visualize the elements of urban planning, and introduce solutions such as transportation, real estate, energy, water, food production, and lighting.

In order to explore the specific application effects of virtual reality technology in assisting shared urban design, this paper has consulted a large number of related materials. Among them, Yufu introduced the characteristics and application scope of VR technology in detail in the article, analyzed the current development status of VR technology in China, rounded up the advantages and disadvantages of VR technology, and emphasized that VR technology is a cutting-edge technology of science and technology [4]. Navarro pointed out that VR technology involves computer graphics, sensor technology, dynamics, optics, artificial intelligence and social psychology and other research fields, it is a new direction for the development of multimedia and three-dimensional technology, virtual reality technology is an immersive type based on computable information, the interactive

environment will greatly improve people's visual and auditory experience [5]. Ma pointed out in the article that VR technology can enhance people's sensory effects, and give people an immersive feeling by enhancing the sense of immersion, compared with traditional 2D multimedia technology, it has a huge advantage and emphasizes that VR technology can be used in urban design. [6]. In the article, Diao introduced the sharing city development concept and China's sharing city planning and design strategy, discussed the advantages and disadvantages of common cities, and gave reasonable suggestions on the future development trend of sharing cities, and emphasized that the sharing economy is one [7]. Yu found through research that virtual reality technology-assisted shared urban design can improve design efficiency, planning management efficiency, reduce comprehensive waste of human and material resources, and improve the rationality of planning and design, at the same time, the efficiency of obtaining government approval is also greatly improved, the feasibility of real-world technology-assisted shared urban design [8].

In the research on the specific application effects of virtual reality technology-assisted shared urban design, this article summarizes and analyzes the research experience and results of a large number of predecessors. In addition, this article has made some innovations in the research content and detection methods. The specific innovations are as follows: Points: First, from the perspective of virtual reality technology and shared urban design, draw lessons from related theories of spatial cognition, analyze and summarize the rules of VR application in shared urban design, supplement the theoretical basis of current VR application research, and expand its research perspectives. At the same time, it provides an effective theoretical basis for the construction of VR methods. Secondly, for the first time, a virtual reality method for shared urban design with public participation is proposed and constructed. In order to follow the summary rules of VR applications, build a standardized VR method process, steps and focus of VR application guidelines, you can make full use of VR Advantages, avoid affecting people's cognitive evaluation elements and limitations, realize the realization of the content of public participation in participatory urban design, realize two-way communication, and increase the participation of public participatory urban design.

2. Shared City Development and Application of Virtual Reality Technology

2.1 About the Development Concept of Sharing

As a new concept, the sharing economy is accepted by more and more people. Many scholars believe that economic sharing with its own unique advantages will eventually replace the traditional economic model and become the mainstream economic model of the future society [9]. In the era of industrial society, cities have benefited from the substantial improvement in productivity and achieved considerable development. However, after entering the information society, people have new ideas for the future development of the city [10]. In the old industrial era, the normal solution to the contradiction between urban development demand and supply was to continuously increase productivity. Due to the unequal distribution of resources and the insufficient utilization of idol resources, cities are isolated, slowed down, and efficiency deteriorated. Under such a social background, the sharing economy provides new ideas for the development of new cities in the future, that is, to build a shared city [11]. Due to innovative attempts and long-term development, China's urban development has entered a new stage. In this special historical era, the original old development model gradually lags behind the pace of development of the times, and the change and development of cities have become the main issues at all levels of the Chinese government. With the rapid development of information technology, modern information technology has changed our lives, and more and more information technology is applied to our country's urban construction [12]. Shared city is a highly developed form of urban development based on the sharing economy. Different from the previous urban development model, the balance of demand and supply cannot be met by sharing the city and increasing productivity, but with the power of information technology, providing sufficient demand and supply can maximize the use of the platform [13]. If the owner of the delivered goods or service is part of the right to use, and the owner of the service or goods that has not been used can trouble others to enjoy it with the least cost.

Compared with the traditional economic model, under the concept of sharing economy, companies can more easily use ready-made network sharing platforms for resource suppliers and demand information providers, and use mature data technology to easily achieve balance. Comprehensive resources are not single from the initial tourism and accommodation to the daily life such as shopping, education, and entertainment [14]. The construction of a shared city is a very complicated task, which

involves cooperation among residents, enterprises, and governments. In order to impose clear restrictions on the respective rights and obligations of shared objects, a series of complete legal norms must be formulated. China has developed rapidly in the field of sharing economy, but it has no experience in building shared cities. In order to allow our country to enter the participating cities of urban transformation more quickly, when internationalization begins, we must learn from experience, develop more mature cities for sharing, and combine our country's actual conditions to carry out development that suits our laws and regulations. According to the clear specifications such as the way and specifications of the shared object, and the law related to the construction plan, the operability of the evaluation is regarded as the shared object, and unnecessary amount is reduced in the development process of participating municipal waste [15]. With the advent of the information society, shared cities have also appeared, and it is only natural to adopt a social and economic system compatible development plan with big data [16]. Establishing a community in a small sharing platform makes it convenient for the residents of the community to use few things themselves, or do not need to share resources and other goods and services. In this way, the community simply realizes the inside of the community, maximizes the use of idol resources, avoids waste in the past, and allows low-income groups in the community to provide more choices. In addition to the above three points, in the future, the development of issues of high social concern such as education, medical care, and health will be shared, and all aspects of society will be integrated into a jointly developed system, forming a new wave of "share for all" [17].

Urban space is a resource, and urban public space is a rare resource belonging to urban communities. It generates great social value and may be optimized and utilized. In the context of urban development, urban space resources have changed from gradual development to inventory space development. Especially in this context, urban space resources have become particularly precious. For the existing large-scale areas in the city, if you do not enter, it will occupy a large-scale urban space, which will lead to the chaos of urban traffic [18]. The concept of open blocks proposed by the central government is also consistent with the idea of shared space. By opening a block, more people can use more urban space. At the same time, by using public transportation, urban residents will share more public resources, alleviate urban traffic congestion, and stimulate the overall vitality and development of the city. By enriching citizens' activities and improving equipment operation rate, more people can share urban facilities. Now, the areas of community public service rooms are almost scattered, and many functions cannot be shared at the same time [19]. Communities are easy to be independent of each other, and there is also the problem of not being able to share equipment. However, if these service facilities can be built in the same area or the same space in the same building, then operating facilities and sports facilities may exist, as well as other necessary infrastructure. The Chevrolet series of centers take infrastructure as the theme, and the operating facilities function as supplementary food and maintenance centers.

2.2 Application of Virtual Reality Technology in Urban Planning

"Virtual reality" technology is called VR technology, which uses computer technology to generate real three-dimensional sensory worlds such as vision, hearing, touch and smell, allowing users to use natural skills from their own perspective [20]. Some devices are used for browsing and interactive investigations in the virtual world. Due to its unique multi-sensory, immersive, interactive and self-discipline nature, virtual reality technology is also widely used in the aerospace, military, medical, education, and even gaming fields. Urban planning is one of the most urgent areas, because of its relevance and high requirements for the future; it is always a new visual technology [21]. From overall planning to urban design, the description of the status quo and the future (immersive city experience, real-time landscape analysis, building height control, multi-scheme urban space comparison, etc.) is the formation of the unique urban style at each stage of the human living environment improvement and planning, and the decision maker. Planners, urban construction managers, and ordinary citizens play various roles in urban planning, and effective cooperation is a prerequisite to ensure the ultimate success of urban planning [22]. VR technology provides an ideal bridge for this cooperation. Using VR technology, government planning departments, project developers, project leaders, and ordinary people can confirm plans from interactive effects in real time from all angles, and better grasp the city [23]. Because of the understanding of the morphology and the design intention of the planners, the macro decision-making of the decision makers will become a more organic factor in urban planning, realizing public participation. This cannot be achieved with traditional methods such as floor plans, rendering, sand tables, or even animation. VR technology is similar to popular 3D animation. At the same time, it uses powerful 3D modeling technology to construct a real 3D scene and reproduce the planned project in a practical way [24].

The city is a complex and huge system, including land use, buildings, local government facilities and other subsystems, each of which has a complicated spatial relationship. Although CAD design has been widely realized based on the space design and management in the field of architecture and urban planning, the two-dimensional plan and the physical model of the traditional performance process stage are still in the discussion and management stage [25]. Although the actual digital design and management in the field of urban management, or the application program that stays in the two-dimensional GS data stage, has not risen to 3d, the stage up to the 3rd dimension is a trend. Virtual reality technology evaluates these detailed data and related information through intuitive and real treatment plans, performs actual simulations of three-dimensional modeling and current and future cities, and compares and optimizes data analysis and plans, and supports geographic information systems. Audit and management, as well as other daily operations, and more importantly, it can participate, and multiple departments can jointly provide an effective platform. This is also the main reason for the widespread use of virtual reality in digital cities [26]. The virtualization in the urban environment plan has many characteristics such as a huge amount of data, and is a typical large-scale scene presented in real time that meets technical requirements. Therefore, it is necessary to form the following high-performance computer. In places such as computer graphics workstations, it is difficult to achieve the goal of building a virtual city environment on the Internet, so it is necessary to explore other software solutions. When specific software development requires large scenes and other skills, in order to improve the rendering speed, various algorithms such as model P with multiple levels of detail and multi-resolution technology have been proposed at home and abroad.

Urban planning based on VR technology can not only use the layout plan and design of urban roads, and the architectural form, but also use data such as population density and temperament to guide the analysis of the rationality of the urban plan. Here, two-dimensional renderers and distribution maps are mainly generated [27]. When displaying the planning results, VR technology can be used to explain the planning results to users in a timely manner. In this way, humanitarian care is more appropriately reflected and users can more easily understand the planning results. Make full use of speech synthesis and recognition, or through further development of speech technology, to realize the virtual city environment of multi-user remote voice communication, simpler program evaluation, combined with voice agent technology users, can use operations to give speeches in the virtual environment [28]. Dialogue with virtual environments, etc., to realize the correct application of embedded VR technology in urban planning. In the process of building a virtual city, the multi-user environment has not yet appeared, but the technical conditions for realizing the multi-user environment are now mature. In the near future, communication between users' avatars will be realized in the virtual city environment, which can better reflect your sense of immersion. Based on the realization of the multi-user virtual city environment, the existing network communication mechanism is used to implement the remote coordinated design of the urban planning plan, and multiple people participate in the plan review and change processing. With the deepening of research on human animation technology and virtual life technology, the functions of VR technology in urban planning and design are further expanded and integrated. If you just stay on the three-dimensional world static blueprint of the current urban planning, the urban development lacks sufficient scientific foundation, lack of quantitative data, and lack of dynamic analysis is the rationality of the planned results. It is necessary to greatly reduce the feasibility of sales, and changing the CIS information can be the biggest use the report to the limit, inherit the population and environmental pollution of urban traffic, etc.

3. Research on Virtual Reality Technology in Urban Design

3.1 The Goal and Purpose of Research

The purpose of this article is to explore the specific application effects of virtual reality technology-assisted shared urban design, and at the same time supplement the theoretical basis and research perspectives of VR applications, and provide the feasibility, limitations, and advantages for the construction of VR methods for shared urban design. The theoretical basis of influencing factors. Try to standardize the construction of a shared urban design VR method, realize the display of urban design content, obtain and use public evaluation feedback, to guide the scientific application of VR in shared urban design. Take the district-level local shared urban design project as an example to conduct preliminary application and test of the method, and evaluate the application effect of VR technology in shared urban design.

3.2 Construction of Virtual World System

The application of VR technology in the shared city plan cannot be separated from the cooperation of the urban design institute, and the planning information of the design institute must be obtained. First, obtain the traffic lines, mountains, and lakes of the new district, and then obtain the distinction between residential land and business district in the new district. Finally, divide the information in detail, obtain the coordinates of the X, Y, and Z axes, convert them into digital information, and build a 3D model. To apply VR technology to urban planning, hardware and software preparations are required. The hardware requires a server, a VR headset with a sound system, an information receiver, and data gloves. The software requires software for 3D modeling, a platform for resource integration, and software for display. Choosing the software and hardware of the construction platform not only needs to meet the operational effect, but also needs to reduce the hardware requirements as much as possible. The source data is established to build the virtual world. First, construct buildings and natural objects and other 3D solid models through the material images created by photoshop, and then use technologies such as skins, animations, and 3D effects such as solid texture, texture and shadow changes to make the physical model of the visual effect more realistic p. The three-dimensional effect is an essential element to ensure the reliability of the scene. As the user's perspective changes, these effects will also change, increasing the immersion of the virtual world, thereby eliminating the gap between the user and the virtual world. Through C programming, optimize the system UI interface, model actions, and model material textures. If there is a time difference between virtual and actual, it is necessary to debug and inspect the system to confirm whether the cause is an error caused by internal algorithms or hardware equipment. This requires continuous testing by customers and trial operation by engineers.

3.3 3D Modeling

Based on AutoCAD, the data of the shared city was classified and extracted, and the original model was established. According to the actual spatial layout of the shared city, the local characteristics of the 3D model need to be depicted through AutoCAD and 3DMAX, and the 3D model is filled with SketchUp (the main SketchUp) to finally generate a virtual shared city 3D model. After modeling, real-time rendering technology is used to reduce the complexity of the final scene and improve the fidelity of the 3D model. With the help of VRMMLPAD development tools, use VRMM real-time dynamic interactive programs to enrich urban planning and management actions. The inline nodes of the VR system can seamlessly connect to urban space scenes and realize space roaming. The entire shared city is divided into several spatial scenes, using OpenGL and computer physical memory for graphics rendering, the scene becomes more realistic. If the virtual memory of the computer does not meet the design requirements, the scene can be dynamically divided. In order to compare and analyze the virtual multi-plan and design plan in the virtual three-dimensional space, a real-time multi-plan database is established.

3.4 Urban Design Content

The shared city design in this article mainly refers to the physical space design of the city. The physical space design of the city includes the overall planning of rational unity, function, intelligent growth, and adaptation to changes. These objects focus on the functions and values of administration and cities. In design and urban planning, we usually understand the attributes of public policy, focusing on the physical space of the city behind the economy, society, politics and resources, without the need for the relationship between the results of public policy. This research structure design method of VR technology is more suitable for part of the micro-scale participatory urban design. VR technology is used to change VR technology in public reception areas of a specific spatial scale. The content of the dominant visual space sequence participation includes: the overall "local" recognition know-walking in multiple local small spaces, using automatic roaming, to realize the objectification of the entire space, the attribute characteristics of each local space entity. The person in charge of urban planning recognizes that local urban design in the micro-market is an indispensable foundation for the entire urban design.

3.5 Questionnaire and Statistics

According to the requirements of this research, and on the basis of referring to a large number of relevant materials in this article, three questionnaires were developed for urban planners. In order to

understand the specific conditions of design efficiency, urban planning management efficiency, reduction of waste of resources and improvement of design rationality, questionnaire 1 "Can virtual reality technology assisted shared urban design improve design efficiency" and questionnaire 2 "Virtual reality technology assisted sharing Can urban design reduce waste of resources. Follow-up interviews with designers, using the correlation analysis of two measurement results or difference tests to evaluate the reliability of the questionnaire, and at the same time, a reliability test was conducted on a related urban planning designer. The correlation coefficient of the research questionnaire is 0.96, which proves the credibility of the research results. The statistical data of the recovery rate of the questionnaire survey is shown in Table 1.

Table 1: Statistics on the recovery rate of the questionnaire

Questionnaire type	Issue questionnaire	Effective response to questionnaires	Effective recovery rate
Questionnaire one	300 servings	292servings	97.3%
Questionnaire two	300 servings	295servings	98.3%
Questionnaire three	300 servings	290 servings	96.6%

4. Analysis on the Application of Virtual Reality Technology to Aided Shared Urban Design

4.1 Analysis of the Impact of Virtual Reality Technology-Assisted Shared Urban Design on Perception Intensity and Design Efficiency

The statistical survey results show that the previous two-dimensional GIS data processing technology is used to plan and design shared urban spaces. Urban information processing is mainly based on graphic design drawings, data tables, and sand table models. It is difficult for urban planning designers to integrate the shared urban space. The data model is connected with the real scene, so the production efficiency is low and the work enthusiasm is not high. The use of virtual reality technology for urban planning and design can effectively improve the enthusiasm of designers. The statistical results of this article show that the work enthusiasm score of designers under the traditional urban design method is 9.35, while the use of virtual reality technology for shared urban design, the work enthusiasm score of designers is 15.68. Table 2 shows the work enthusiasm scores of designers of traditional design methods and virtual reality technology design methods.

Table 2: Traditional design method and virtual reality technology design method designer work enthusiasm score

Group	Early work enthusiasm	Mid-term work initiative	Work enthusiasm	Overall rating
Traditional way	8.63±1.45	9.47±1.33	10.36±1.85	9.35±0.84
Virtual reality technology	10.69±1.58	13.62±2.18	16.72±2.66	15.68±2.74
P	P<0.05	P<0.05	P<0.05	P<0.05

Research has shown that designers' experience when using VR technology for shared urban design is significantly higher than that of traditional two-dimensional design methods. VR technology can use the computer's powerful computing and graphics processing capabilities to provide technical means to display the original object's vision, touch and hearing. Based on survey data, virtual reconstruction and simulation can be used to display roads or buildings in a shared city. Regarding the changes in the participatory urban space, the continuity of the streets, the space surrounding the space, the construction order, the heat, the coordination of the space, and the comfort of the content, it is felt that the level of VR technology is quite different, and the VR method has obvious advantages in planning. Urban design, verification, based on VR's multi-sensory continuous movement, observation points, and spatial construction advantages, which are conducive to spatial change, continuity, and the relationship between spatial elements (style), presenting intuitiveness in the form of scale and surrounding environment, and at the same time. Conducive to increase the source of inspiration for designers. The results of the study show that the virtual reality technology-assisted shared urban design is beneficial to improve the intuitive experience of urban planners. The specific data is shown in Figure 1.

From the data in Figure 1, it can be seen that the virtual reality technology-assisted shared urban design is conducive to improving the intuitive experience of urban planning designers, increasing the visual and tactile intuitive experience of designers by 68.3%, thereby increasing the designer's source

of inspiration.

Research shows that VR technology can represent the real world and the virtual world. According to the real world, it can break through the limitations of physical space and time, and be able to surpass reality. In the virtual world, virtual objects can make them show a three-dimensional sense, achieve an immersive feeling. Beyond their freedom, freely enter and exit the interaction of 3D information space. This interaction is an interactive 3D environment generated by a computer, which not only enables participants to feel the reality of the landscape or model, but also makes the player's movement and the operation can respond accurately in real time. With the application of virtual reality technology, urban planning and designers can simulate and traverse the computer, observe the design plan, and stay at any time to discuss the planning plan of the key area, and check the relationship between the plan and the surrounding environment when checking the plan. Similarly, in the plan approval process, the plan can also be made into a 3D model and combined with the current 3D model to generate a plan approved 3D model, which greatly improves the efficiency of shared urban design. The research results show that virtual reality technology-assisted shared urban design can improve design efficiency. The specific data is shown in Figure 2.
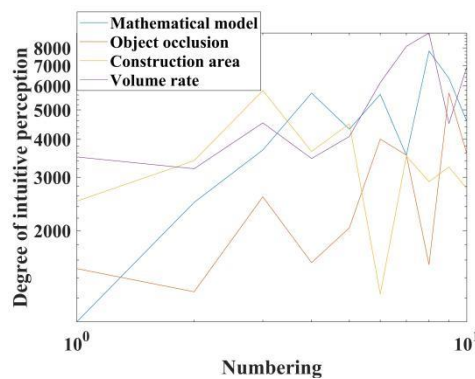

Figure 1: The impact of virtual reality technology-assisted shared urban design on the degree of intuitive perception of urban planners
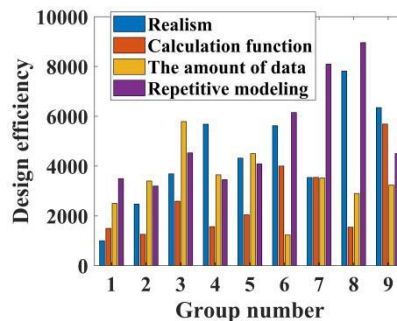

Figure 2: The effect of virtual reality technology-assisted shared urban design on the efficiency of design work

It can be seen from the data in Figure 2 that virtual reality technology-assisted shared urban design can improve design efficiency and increase the efficiency of urban planning and design by 35.2%.

4.2 Analysis of Application Effect of Virtual Reality Technology Aided Shared Urban Design

The statistical survey results show that by using VR technology, various urban planning and design schemes can be placed in the real environment. After adding the planning scheme, the impact on the real environment can be investigated and the rationality of the scheme can be evaluated. Complex structure construction plans and construction structure calculations can use virtual reality technology. In a virtual environment, structural components and mechanical equipment are set up around the site. For example, a 3D model of a computer simulation system based on certain functions is formed, so that according to the results of virtual assembly. The system model with dynamic performance and the system model of virtual assembly are modified in the visual environment of human-computer interaction. The visualization of geographic information system based on virtual reality technology can process more complex 3D data more realistically and intuitively, and can quickly and accurately query

and count participatory city management information, effectively analyze city information space, and support city information. Intensified and deepened urban management work can quickly and accurately update urban conditions, while ensuring that the information in urban management work is effective. At the same time, 3d planning schemes can be published and reviewed on the Internet. In this way, the effect of publicity and display of government affairs and social information can be realized, and the efficiency of urban planning management and design quality can be greatly improved. The research results show that virtual reality technology-assisted shared urban design can effectively improve urban planning management efficiency and design quality. The relevant data is shown in Figure 3.
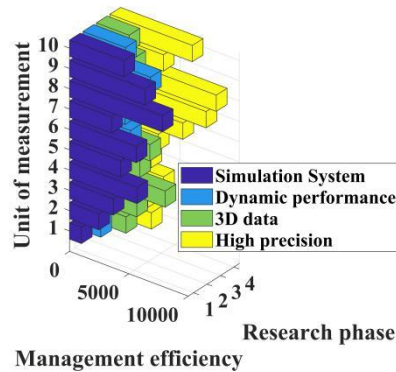

Figure 3: The impact of virtual reality technology-assisted shared urban design on urban planning management efficiency and design quality

From the data in Figure 3, it can be seen that virtual reality technology-assisted shared urban design can effectively improve the efficiency of urban planning management and design quality, increase planning management efficiency by 24.8%, and increase planning and design rationality by 29.5%.

Through this research, it is found that the further development of VR technology in some aspects will greatly promote its application in urban planning and design. The rapid modeling method in virtual reality technology is of great significance for large-scale shared urban construction projects. In the actual design process, terrain will be quickly generated and dynamically scheduled, and the amount of terrain data is large. If there is no better scheduling mechanism, it will affect the overall performance of the system and reduce work efficiency. Due to the existence of many modeling software and different result formats, extensive data compatibility is conducive to reusing existing results and effectively avoiding the waste of repeated modeling. Virtual reality technology can provide an auxiliary development interface to facilitate the connection between more professional analysis models and the VR platform. It's simple system achievements and professional system achievements can be smoothly converted, so VR scenes can work normally in various system environments, and virtual reality technology can realize shared urban design in one step, avoid detours, and save a lot of manpower and material resources. The research results show that virtual reality technology-assisted shared city design can reduce the comprehensive waste of human and material resources. The specific data is shown in Figure 4.
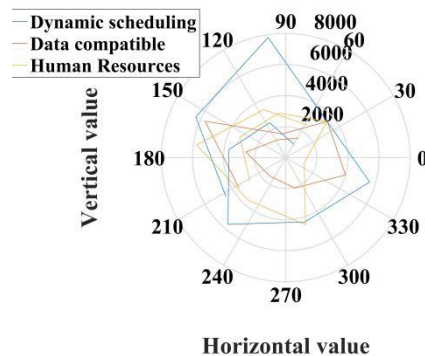

Figure 4: Virtual reality technology-assisted shared urban design has less effect on the comprehensive waste of human and material resources

It can be seen from Figure 4 that compared to the traditional two-dimensional design method; the virtual reality technology-assisted shared urban design can reduce the comprehensive waste of human

and material resources, and reduce the comprehensive waste of human and material resources by 21.2%.

5. Conclusions

(1) Virtual reality (VR) technology integrates various technologies such as simulation, multimedia, network, computer graphics human-machine interface, and sensing. It is a very challenging frontier subject and research field at present and in the future. With the gradual maturity of VR technology and development, VR technology has been applied to many fields. Because VR technology can create a virtual world simulation system for people to experience, VR technology is often applied to urban planning and design.

(2) The research results show that the use of virtual reality technology for urban planning and design can effectively improve the enthusiasm of designers, and the virtual reality technology assisted in shared urban design is conducive to improving the intuitive experience of urban planning designers, making them visual and tactile. The intensity of intuitive experience is increased by 68.3%, thereby increasing the source of inspiration for designers. Virtual reality technology-assisted shared urban design can improve design efficiency and increase the efficiency of urban planning and design by 35.2%.

(3) The study found that virtual reality technology-assisted shared urban design can effectively improve urban planning management efficiency and design quality, increase planning management efficiency by 24.8%, and increase planning and design rationality by 29.5%. Compared with traditional two-dimensional design methods, virtual reality technology-assisted shared urban design can reduce the comprehensive waste of human and material resources, and reduce the comprehensive waste of human and material resources by 21.2%. Therefore, it can be seen that virtual reality technology to assist shared urban design is feasible and will surely become a new development trend in the field of urban planning and design.

Acknowledgements

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