

# Reflections on the Future of Smart City Planning Urban Furniture Design Based on Sustainable Development Goals

Ke Qin<sup>1,\*</sup>

<sup>1</sup> University of New South Wales, Kensington Campus, Kensington, NSW 2052, Australia

\*Corresponding author. Email: z5176941@zmail.unsw.edu.au

## ABSTRACT

With the breakthrough development and widespread application of information technology, smart cities are increasingly becoming the development direction of urban construction and planning. At present, the status quo of the traditional urban furniture design, such as insufficient intelligence concept and lack of humanization, has been difficult to deal with the changes occurring in today's city. Based on the analysis of the vision of the future city, this paper expounds the relationship between smart cities and sustainable development from the perspective of the Sustainable Development Goals and the current state of furniture in Europe, America, and Asia. Based on the interaction of technology, socio-economy, management, space and other elements, this paper integrates the concept of smart development into the urban planning system to solve the key problems of urbanization development.

**Keywords:** *Smart Cities, Urban Furniture, Low Carbon Cities, Collaborative Planning, Sustainable Development.*

## 1. INTRODUCTION

Human society has experienced long historical changes. The electrical revolution, industrial revolution and information revolution have promoted the urban form into a new era of artificial intelligence urban construction. At the same time, problems such as resource shortage, environmental pollution, ecological damage and traffic congestion also affect the quality of urban development. To promote the development of social and economic transformation, IBM proposed the concept of the smart city in 2009, which aims to meet the requirements of urban sustainable development through a series of information technology and intelligent means [1]. Kevin Lynch pointed out that roads, boundaries, neighborhoods, nodes and sign bodies are the five elements that constitute the urban image and intention system [2]. Urban furniture is an important part of the street. Although urban furniture is relatively small, it also intuitively reflects the image and temperament of the city.

Urban furniture is a public resource within people's reach, carrying the diversified needs of urban citizens. It is also the primary research topic of urban furniture design to combine intelligent design concept with intelligent technology to fundamentally improve the overall design and functional quality of urban furniture, so as to promote the improvement of urban image and

people's quality of life. On the one hand, the continuous development of information technology has further deepened the trend of intelligent product design. On the other hand, people have long been accustomed to the life of information technology and have certain requirements for the informatization degree of urban furniture. Intelligent products have been the development trend of industrial product design, and there are similar signs of intelligent development in the field of urban furniture. How to make urban furniture meet the needs of the city in many aspects, which can not only show its own function, aesthetic and even educational value, but also more intuitively show the city image, is a very worthy academic topic. However, due to the constraints of many factors, the development of smart city furniture is still in its infancy.

## 2. SMART CITIES AND URBAN FURNITURE

### 2.1 Smart City

IBM believes that smart city refers to a city that makes full use of information technology in its jurisdiction environment, public facilities, urban services and local industrial development to create a better environment to live, work and rest and play [1]. Part of

the literature mainly focuses on how smart cities can guide the efficient development of cities for policies. For example, in 2000, the United States put forward the concept of “smart growth” and took it as the principle guiding urban planning and construction [3]. Another part of the literature focuses on the role of information technology on urban functions. The development of information technology and Internet has led to the emergence of urban organizations such as “digital city” and “information city”. In this study, the definition of “smart city” is an intelligent city management method, which aims to transform and strengthen integrated urban management and public services, realize intelligent development, efficient governance, and meet people’s information needs.

With the further development of information and intelligence technology, countries all over the world are committed to the research upsurge of “smart city”, among which the most representative are Europe, the United States and some Asian countries. The EU has spared no effort to promote the construction of the information society and completed the third stage development strategy of the “E-Europe” action plan by 2010. The United States established the International Smart Cities Organization (ISCO) and conducted the annual World Smart Cities Awards [5]. By implementing the I-Japan strategic plan, Japan has become a model country for the construction of global smart cities [6].

## **2.2 Urban furniture**

The term “urban furniture” originated in Europe and appeared in the 1960s [7]. With the increase of outdoor activities, the concept of “furniture” was extended to outdoor spaces. For example, street lamps are like floor lamps at home, while lounge chairs are like chairs at home. Urban furniture refers to the general term of all apparatus and facilities scattered in urban streets, squares, parks and other urban public environmental spaces, providing public service functions for the public and displaying the image of the city. From the macroscopic point of view, urban furniture includes the visual material existence in urban public space characterized by product elements, and from the microscopic point of view, it refers to the public service facilities in the street space. “Urban furniture” plays an important role in urban planning and construction and is of great significance to improve the quality of life of the urban public, because it accurately interprets people’s desire for the beauty of the city as well as the family environment.

Jacobs regards furniture in the street as crucial elements, “sometimes decisive for the entire street” [8]. While the importance of it is still underestimated. In the whole urban system, urban furniture, as an urban terminal facility, has the closest relationship with people’s life. A wide variety of urban furniture brings a rich and colorful

urban life to the public. As the concrete expression of urban image, urban furniture redefines the functional characteristics of public space and enriches the definition of environmental landscape. Urban furniture not only brings visual enjoyment to the urban public, but also stimulates the interaction of urban residents and make the cold urban public space full of vitality.

## **3. FUTURE SMART CITIES AND SUSTAINABLE DEVELOPMENT**

At present, smart cities have become a globally recognized urban action guide, and more and more cities are exploring and practicing smart cities. Smart cities takes intellectual and social capital, infrastructure investment including traditional transportation and modern information and communication technology as the driving force to support sustainable economic growth, and intelligently manages the above capital and natural resources through participatory governance to achieve high-quality life [9]. Smart city construction contributes to the sustainable development of cities from the perspectives of technology, economy, society, management and space, and reflects the importance of ICT(information and communications technology), social and environmental capital to enhance the competitiveness of the city and achieve harmonious and sustainable economic, social and environmental development [10].

### **3.1 IBM’s Smart City Practice**

IBM’s “Smart City Management System” has been successfully applied to the construction of a smart city in Rio de Janeiro, Brazil [11]. Even though Rio de Janeiro faces various problems in building a smart city, such as complex urban infrastructure, mountains and seas, diverse geographical environment and frequent natural disasters, IBM’s Smart City Management System can monitor, analyze and integrate various information data and synchronize with multi-platform publishing systems such as telephone, SMS and twitter, effectively respond to urban management problems such as accidents and emergencies. The management system makes it possible to establish links between information data from previously independent and scattered and unconnected systems (such as transportation and water resources), so that the system can easily analyze and make decisions.

### **3.2 Singapore’s Smart City Practice**

Singapore has put forward the “Smart Island” and “Smart Nation 2015” plans as well as the “Smart Nation 2025” plan, and has made bold explorations and attempts in urban informatization, digitalization and intelligent technologies [12]. Singapore’s smart city construction focuses on the development blueprint of information technology recognized by the whole people, and on urban

management and services to the public in a variety of areas such as smart government, smart transportation, smart medical planning and construction. The government has invested S\$4 billion in the renovation and upgrading of urban infrastructure and the construction of information infrastructure to realize the top-level planning, underlying design, information interconnection, data sharing and exchange of the construction of “Smart Island” information system.

Singapore’s intelligent traffic management system provides people with accurate and timely information about road traffic, which makes the relationship between road users and traffic system closer. This intelligent management mode helps people make accurate and timely judgments on public transportation routes, traffic travel modes and travel times. In terms of intelligent urban furniture construction, Singapore has installed sensors and monitoring equipment connected to optical fiber in street lights and bus stops. Environmental quality sensors and traffic surveillance cameras transmit air pollution and traffic congestion back to the intelligent control center for relevant personnel to take measures.

Therefore, based on the development of intelligent technology, this paper discusses the spatial organization and planning of smart cities from the perspective of integrated and coordinated development of technology, society, economy, institution and space. Through the construction of intelligent urban infrastructure and the creation of urban functions, we strive to realize the transformation of urban socio-economic development and healthy urbanization.

### ***3.3 Vision of sustainable development of smart cities***

The construction of smart cities helps to realize the sustainable development of the city from different perspectives such as nature, society, technology, economy, society, management and space. It is generally a strategic concept of all modern urban production factors, reflecting the growing importance of ICT, social and environmental capital to enhance the competitiveness of cities and is committed to the harmonious and sustainable development of its economy, society and environment [13]. Smart city construction can achieve sustainable development in the following ways:

#### ***3.3.1 Natural Ecology***

The difference between green eco-city and traditional city is that eco-city pay more attention to the relationship between people and nature. It is an ideal form of diversified development with the organic combination of economy, society and environment, and ecological virtuous cycle. At the same time, sustainable urban development is the ultimate goal of smart city

construction, which refers to the ideal state of coordinated development and organic balance among economic development, environmental protection and social equity in the process of urban construction. Ecological sustainability and social sustainability are the basic elements that constitute a sustainable city. Economic sustainability as the core, social sustainability as the extension, ecological sustainability as the ultimate goal, and finally form a livable park city.

#### ***3.3.2 Social Ecology***

The original intention of smart city construction is green sharing city. Smart cities can effectively influence and enhance people’s innovation potential through information technology, promote cooperation, connection, and sharing, and form the concept of “shared cities”. The people-oriented sharing model of smart cities, with the participation of citizens and the public, is a powerful driving force for the fair and just development of the urban social ecology.

#### ***3.3.3 Information Technology***

Smart city needs to rely on the new generation of information technology and urban innovation to form a smart city system. The construction of intelligent urban infrastructure and the creation of urban functions help to transform urban social and economic development, improve urban spatial efficiency and improve residents’ quality of life. Through the effective integration of social resources and information technology, smart cities can achieve sustainable development.

#### ***3.3.4 Urban Space***

Smart cities use innovative technologies to make public space and street space more inclusive for different groups and suitable for the elderly, the disabled and other groups to live in the community through a more equitable distribution of resources. As a result, smart city construction can promote urban technological innovation, improve the innovative development capacity and operational efficiency, and realize ecological, low-carbon, coordinated, equitable, and sustainable development [14].

## **4. VISION OF FUTURE URBAN FURNITURE**

The development of Internet information technology has had a transformative impact on the organization and element layout of urban production and living space, and put forward new requirements for the concept, objectives, methods and contents of urban planning. In the context of sustainable development, how to integrate the concept of smart city development into the existing urban planning system and content, carry out

collaborative planning and design, innovate planning concepts and methods, and provide scientific, fair, and efficient services has become the top priority of urban planning innovation.

Urban furniture has been playing the role of urban public service and is developing towards intelligence and intelligence. There is a symbiotic and co-developmental development relationship between urban furniture and scientific and technological progress. On the one hand, with the development of science and technology, new materials, new processes, new energy and other new technologies have dramatically promoted a series of changes from design to production of urban furniture. On the other hand, science and technology not only has changed the urban lifestyle, but also caused many social and cultural problems.

With the development of urban modernization, urban furniture has also realized modernization. Traditional urban furniture began to die out, and intelligent urban furniture gradually became popular, basically replacing the dominant position of traditional urban furniture. Artificial intelligence urban furniture also began to popularize. They are active in various service areas, such as robot garbage cans and self-driving clinics, etc. The overall level of urban furniture has reached the level of the primary stage of artificial intelligence. During this period, the form and content of urban furniture have undergone qualitative changes, and the own attributes of urban furniture are no longer obvious. The future of urban furniture will emerge under the following conditions:

#### **4.1 Smart city furniture**

In urban strategic planning, the feasibility and priorities of smart city construction and the top-level design of smart cities are the key points. At the level of the overall planning of smart cities, we should establish the construction objectives and scale, implement the spatial layout of smart production, smart life and smart ecology, and design according to the requirements of “livable city”, “ecological low-carbon city” and “sustainable city”.

#### **4.2 Collaborative Planning of Smart Urban Furniture**

The intelligent robot of “self-driving + unmanned retail + shared services” will completely overturn the traditional concept of urban furniture and bring people a new and more comprehensive service experience. Retail, service-oriented and functional urban furniture will be transformed into mobile robot urban furniture. Intelligent urban furniture will deeply expand the use space and execution efficiency of urban furniture and improve the overall service level.

#### **4.3 Public art of urban furniture:**

The future city is a big garden, so urban furniture to decorate the urban public environment is essential. Seats, flower beds, and other urban park auxiliary facilities of urban furniture will be more personalized and interesting landscape installations and public art. At the same time, the future public art of urban furniture does not exclude the application of modern technology. In addition, the future of urban furniture will emphasize the interactive experience of public services and the direct participation of public. Various design concepts such as do-it-yourself and movable, will once again activate the vitality of the streets.

#### **4.4 Technological innovation of urban furniture planning**

Some urban furniture also belongs to a part of urban infrastructure, such as fire hydrants, manhole covers, electromechanical boxes, etc. For this kind of urban furniture, it is enough to achieve intelligent dynamic management. Therefore, the focus of future upgrading of such urban furniture is to carry out intelligent transformation and upgrading. Taken together, the city of the future will realize roboticization, and the advanced artificial intelligence robot urban furniture will occupy a dominant position. They will provide people with a variety of public service experiences with good interaction and high service efficiency.

### **5. CONCLUSION**

Smart city construction is an important way and technical means to achieve sustainable development, not the ultimate goal of urban development. In addition to making full use of intelligent technology, urban furniture design should also establish a new theoretical system of intelligent urban furniture design based on human needs. In urban planning and construction, the concept of intelligent development is fully integrated into the organization and planning of urban space through the construction of data and information platform and the use of intelligent applications. Through the comprehensive study of emerging technology outlook, future city theory, smart city practice and urban development planning, this paper puts forward the theoretical system of smart city furniture design, and believes that the future city is a smart city integrating compactness and diversity, green ecology and intelligent innovation. Robotic urban furniture will be the inevitable trend of urban development in the future.

### **REFERENCES**

- [1] Cocchia, A. Smart and digital city: A systematic literature review. *Smart city*, 2014, pp.13-43.DOI:

- [https://link.springer.com/chapter/10.1007/978-3-319-06160-3\\_2](https://link.springer.com/chapter/10.1007/978-3-319-06160-3_2)
- [2] Huang, J., Obracht-Prondzynska, H., Kamrowska-Zaluska, D., Sun, Y., & Li, L. The image of the City on social media: A comparative study using “Big Data” and “Small Data” methods in the Tri-City Region in Poland. *Landscape and Urban Planning*, 2021, DOI: <https://www.sciencedirect.com/science/article/pii/S0169204620314602>
- [3] Pollard, T., & Pollard III, O. A. Smart growth: the promise, politics, and potential pitfalls of emerging growth management strategies. *Virginia Environmental Law Journal*, 2000, pp.247-285. DOI: <http://www.velj.org/smart-growth-the-promise-politics-and-potential-pitfalls.html>
- [4] Gore, A. Bringing information to the world: The global information infrastructure. *Harv. JL & Tech.*, 1996. DOI: <https://repository.law.uic.edu/jitpl/vol16/iss4/5>
- [5] Byun, J., Kim, S., Sa, J., Kim, S., Shin, Y. T., & Kim, J. B. IoT (internet of things) based smart city services for the creative economy. *International Journal of Smart Home*, 10(7), 2016, pp.185-192. DOI: [https://gvpress.com/journals/IJSH/vol10\\_no7/19.pdf](https://gvpress.com/journals/IJSH/vol10_no7/19.pdf)
- [6] R. Shabadi, Mihail Ionescu, M. Jeandin, C. Richard and Tara Chandra, Cast iron metalworks in european urban furniture dating back to the 19th and the early 20th centuries. In *Materials Science Forum*, Vol. 941, pp. 663-667, 2018, DOI: <https://doi.org/10.4028/www.scientific.net/MSF.941.663>
- [7] Fuller, M., & Moore, R. (2017). *An Analysis of Jane Jacobs's: The Death and Life of Great American Cities*. Macat Library.2017, pp. 98. DOI: <https://doi.org/10.4324/9781912282661>
- [8] Caragliu, A., Del Bo, C., & Nijkamp, P. Smart cities in Europe. *Journal of urban technology*, 18(2), 2011, pp. 65-82, DOI: <https://doi.org/10.1080/10630732.2011.601117>
- [9] Anttiroiko, A. V., Valkama, P., & Bailey, S. J. Smart cities in the new service economy: building platforms for smart services. *AI & society*, 29(3), 2014, pp. 323-334. DOI: [10.1007/s00146-013-0464-0](https://doi.org/10.1007/s00146-013-0464-0)
- [10] Shcherbina, E., & Gorbenkova, E. Smart city technologies for sustainable rural development. IOP Conference Series Materials Science and Engineering 365(2):022039 IOP Publishing. 2018, DOI:10.1088/1757-899X/365/2/022039
- [11] Шкваря, Л. В., & Семенов, А. С. Smart cities: necessity and development strategies. *Информация и инновации*, 15(2), pp. 52-58. 2020, DOI: <https://doi.org/10.31432/1994-2443-2020-15-2-52-58>
- [12] Hollands, R. G. Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City*, 12(3), 2018, pp. 303-320. DOI: <https://doi.org/10.1080/13604810802479126>
- [13] McCormick, K., Anderberg, S., Coenen, L., & Neij, L. Advancing sustainable urban transformation. *Journal of cleaner production*, 50, 2013, pp. 1-11. DOI: <https://doi.org/10.1016/j.jclepro.2013.01.003>