

# Exploration of the Application of Digital Technologies in Urban Ecological Environment Management

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**Abstract:** Urban ecological environment is of great significance for the sustainable development goals of the real world. For the governors of urban ecological environment, it is necessary to protect the natural ecological environment, but also to meet the living needs of urban residents. In recent years, with the deepening of the application of big data, Internet of Things, cloud computing and other technologies in the field of urban ecological environment, remarkable benefits have been achieved in the field of online automatic monitoring of pollution sources, urban air quality forecasting, water environment management, soil environment management, hazardous waste supervision, enterprise public service, etc., which promoted the modernization of ecological environment management, and digital and intelligent management system for ecological environment became more complete. However, there are still deficiencies in the application of data sharing, intelligent application analysis, and macro decision-making ability. This paper elaborates on the application of digital management in urban ecological management.

**Keywords:** urban ecological environment; digital technologies; management applications

## 1. Introduction

In urban ecological environment protection, urban ecological environment infrastructure construction is the key, and the management of the ecological environment protection by urban governors is the guarantee. The purpose is to enable urban residents to coexist harmoniously with the urban ecological environment, to realize the social, economic and environmental benefits for all. The ecological environment provides human beings with the material basis needed for survival and production, including sunlight, air and water, etc. [1], while human beings protect the quality of the ecological environment and biodiversity. With the continuous progress of urbanization and the new requirements of the ecological protection, the management of urban ecological environment is becoming increasingly important.

## 2. Elements of urban ecosystem management

The management of urban ecological environment should start from two aspects, namely, ecological environment protection and urban residents. These two aspects are important factors for the better development of urban ecological environment.

### 2.1 Ecological environment protection

The urban ecological environment is different from the natural ecological environment, and it requires active participation of urban residents. The ecological environment protection, especially the construction of environmental protection infrastructure, is the prerequisite for the sound development of urban ecological environment. The management of urban ecological environment should start from the ecological environment protection [2], and the ecological environment protection should be scientific and forward-looking. Scientifically, it is based on the realities of the city for scientific and reasonable planning and construction of the natural environment, such as the selection of urban green plants, river ecosystem construction and landscape restoration, etc., in order to both protect biodiversity and meet the development needs of the city. Forward looking refers that the urban construction and management personnel should predict urban population size, etc. based on the city's future development trends and demands, in advance of the planning of urban environmental protection infrastructure construction, such as planning for the city sewage treatment plant sites, treatment process and design capacity, planning for

the city garbage dump sites and design capacity, and planning for the city noise isolation measures, etc. From the perspective of long-term development, eco-city construction has become the inevitable trend of China's urban economic development in the future, and it is also the form of the future city. Therefore, in order to achieve this goal, in the construction of urban ecological environment, the staff is required to start from the perspective of ecological management, rationally utilize resources, and ultimately ensure economic benefits of eco-cities and realize sustainable development goals.

## **2.2 Urban residents**

Urban ecological environment management for urban residents calls for citizens to protect the natural ecological environment. This is to enhance the awareness of urban residents to protect the ecological environment and regulate the protection behaviors, on this basis, and then increase some appropriate activities to protect the environment, so that the public personally experience how to carry out environmental protection, thereby improving the urban ecological environment [3].

## **3. Digital technologies in urban ecological environment management**

### **3.1 Internet big data technology**

Internet big data is one of the most important data systems for modernization. Compared with traditional databases, it has significant advantages in terms of acquisition, storage, management, analysis capabilities. And it is characterized by diverse data types, large data processing capability and fast processing speed, etc., and has an important application in the monitoring and statistics for digital ecological environment management [4].

### **3.2 Artificial intelligence technology**

Artificial Intelligence (AI) technology is a new type of digital technology that has emerged rapidly in recent years. Although its application in the field of ecological environment management is still in its early stage, it has great potential for development in terms of the depth and breadth of its applications that can be explored. Along with the increasing improvement of AI theory and technology, the application fields of this technology are gradually expanding and promoting its deep integration with ecological environment management. Artificial intelligence technology is deeply empowering urban economy and life, driving the production and lifestyle to digital transformation. At present, artificial intelligence technology has the ability to integrate big data in the field of urban management.

### **3.3 Internet of Things technology**

The Internet of Things (IoT) is a network that connects objects to the Internet with certain information sensing devices as a link, so as to achieve intelligent identification and management purposes. As an extension and expansion of the Internet, IoT is a powerful driver of industrial development and transformation in the field of new information technology. Combining IoT with other new digital technologies and applying it to the process of urban ecological environment management have a constructive role in overall planning and management processes and enhancing the intelligent management and service capability.

### **3.4 Cloud computing technology**

Cloud computing technology is an emerging Internet-based business computing model that involves multiple management areas and application scenarios. For example, cloud computing technology can play a role in the intelligent control of urban pollutant emissions and the efficient supervision of various types of illegal behaviors. Taking cloud computing technology as a starting point, combining the video surveillance system with it to realize video information association can visually and efficiently monitor large-scale sewage pollutant sources. This type of environmental protection video monitoring system based on cloud computing has the advantages of fast and stable data transmission and accurate control, etc., which can play a role in all aspects of urban ecological environment management and enhance the effectiveness of environmental protection supervision. Cloud computing is still in the early stage of development, and there are still many issues to be addressed in both technical and non-technical aspects to further tap its enormous potential and to form synergistic effects.[5]

#### **4. Application scenarios of digital technologies in urban ecological environment management**

##### **4.1 Data collection**

Through various IoT sensing technologies such as ecological environment online monitoring equipment, video surveillance, drones, satellites, radars, with the help of network data real-time high-speed transmission technology, it is possible to realize the long-term monitoring and automatic transmission of related data such as urban air, surface water, groundwater, pollution sources of enterprise wastewater, and exhaust gas. A large number of ecological environment data are formed by integrating various environment factors such as atmosphere, water, soil, radiation and various pollution sources data. These data play an important role in online monitoring and control of ecological environment [6].

##### **4.2 Environmental regulation**

Using technologies such as mathematical modelling, artificial neural networks, machine learning, recognition and algorithms, we manage and analyze massive ecological environmental data obtained to timely understand and judge the environmental conditions of surface water quality, atmospheric quality, soil, radiation, solid wastes, and pollutant emissions from key polluting units. This provides efficient cloud-based supervision methods for water environment management, atmospheric environment management, soil remediation and other aspects [7].

##### **4.3 Early warning forecast**

By utilizing technologies such as cloud computing, artificial intelligence, machine learning, and predictive analysis models, the collected massive ecological environment data are transformed into knowledge, which makes the comprehensive ecological environment decision-making more accurate and scientific and maximizes the value of ecological environment big data. For example, since the release of the “Ten Measures for the Protection of the Atmosphere” in 2013, the China Environmental Monitoring Station, the Institute of Atmospheric Physics of the Chinese Academy of Sciences and relevant research institutions have jointly developed an internationally advanced numerical forecasting system for urban air quality. The system utilizes real-time monitoring of national real-time urban air quality, mainstream meteorological forecast data at home and abroad, and national inventory of air pollution source emissions and other basic information to analyze and judge the air pollution situation in the next 7-10 days every day [8].

#### **5. Current situation and challenges of digital technologies application in urban ecological environment management**

##### **5.1 High cost of digital development**

The economic investment in the construction of digital management projects is often large. Digital ecological environment management is different from traditional management methods in that it is a management method supported by digital technology, which has significant advantages such as precision, efficiency, real-time, and intelligence, but it also has high requirements for technological pathways and infrastructure. A complete set of implementable digitization technology needs to go through many stages, such as research and development, testing and going live, which will consume a lot of money. On the one hand, digital technology is difficult and requires breakthroughs in many technical bottlenecks, resulting in higher R&D costs. On the other hand, the operation of the digital ecosystem management project requires the support of complex hardware and software equipment, which requires high operating funds. In addition, the digital management project has a long cycle, and as the project advances, the software and hardware equipment need to be inspected regularly, resulting in significant operating costs. According to IDC’s “2019H1 Global Semi-Annual Smart City Spending Guide”, China’s smart city technology-related investment reached about \$22.879 billion in 2019. In the same year, as the world’s “smartest” city, Singapore’s GDP was only 2.6% of China’s, but its investment in smart city-related funds reached 10% of China’s, indicating the huge cost of digital management. Taking enterprises as an example, Midea has invested more than 10 billion yuan in digital management for eight consecutive years, and Qihoo 360 Technology has invested more than 20 billion yuan in the field of digital network security protection system [9]. The three major domestic communications operators and technology companies such as Huawei have invested more than 10 billion yuan in 5G throughout the year [10].

## 5.2 Bottlenecks in digital technology development

Technical support is crucial to digital management, yet the application of existing technologies is still in a bottleneck period, which to a certain extent restricts the upgrading and promotion of digital management. The application of digital ecosystem management depends on the development of digital basic technologies, which puts higher demands on support in terms of funds, policies and talents. The current digital technology in use can be considered just the tip of the iceberg. Therefore, digitalization has strong development potential in the field of ecological environment management. In the future, with the progress of technology, more digital technologies will be developed and applied in the field of ecological environment management to improve the efficiency. For the new issues of networked and software-based technologies in digital ecological environment management, it is also necessary to be constantly revised and improved in the future.(As shown in figure 1)

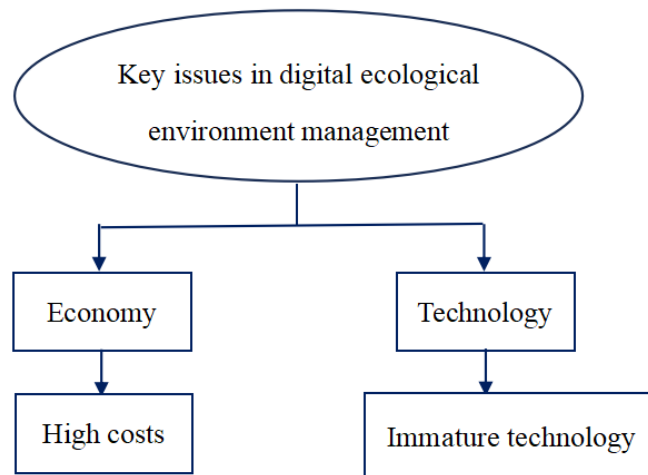


Figure 1: Key issues in digital urban ecosystem management

## 6. Conclusions and recommendations

### 6.1 A sound cost regulatory system for digital ecosystem management

The application and promotion of digital technology in global urban ecological environment management are easily constrained by economic inputs. To address this problem, it is necessary to establish a sound cost supervision system for digital ecological environment management, coordinate planning, improve cost accounting mechanisms, control the software and hardware inputs required for the construction of digital management system, and realize the reasonable allocation of inputs. For the less developed regions, technical support should be provided to avoid wasting time and money, reduce maintenance and operating costs, and promote coordinated regional ecological management. Meanwhile, international organizations should actively carry out cooperation and exchanges, strengthen the awareness of digital ecological environment management, strengthen supervision and play a supervisory role.

### 6.2 Unified standards for digital ecological environment management

The application of digital technology in global urban ecological environment management has not yet scaled up, and there is no unified standard to guide and constraint it. In the process of promoting global urban ecological environment management with digital technology, unified standards, such as data standardization and storage unification, should be established to accelerate the pace of this technology in global urban ecological environment management.

### 6.3 Increasing financial support for urban ecological environment management

Digital technology has high technical difficulty and long development cycles in urban ecological environment management applications, so the government should relax the access threshold of public digitally-driven ecological environment management projects, and increase financial investment to

support the technical support, so as to promote the integration of digital technology in the management of the global urban ecological environment. For example, the government can relax the access threshold of digital ecological environment management projects, adopt tax relief policies for such projects, increase financial subsidies for digital technology research and development, and encourage more digital technology innovation. At the same time, it is necessary to attach importance to talent cultivation, encourage talents to enter the field of digital technology-related fields, strengthen cooperation among local governments, enterprises and scientific research institutions, and form a synergy to promote technological innovation and expand the application scenarios of digital technology in ecological environment management.

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