

# The Operation Method of Smarter City Based on Ecological Theory

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**Abstract:** As the city and urbanization's accelerated pace has caused galloping population, the urban framework is extending with increasingly complex social problems. The urban management tends to become complicated and the governance seems more difficult to pursue. exploring the urban management's new model has attracted local governments' urgent attention. tcombines the guiding ideology and that management's practices based on ecological theory, explains the Smarter city Ecology Managementmodel's formation , makes modern urban management's comparative analysis and further defines the aforesaid management mode's conceptual model.based on the smarter city system theory's ecological carrying capacity, the author uses mathematical model to prove the coordination relationship between the smarter city Ecology Managementmode's subsystems, demonstrates that it can improve the urban management's overall level, emphasizes smarter city management integrity, believing that urban system's optimization is based on each subsystem being optimized, attaching the importance to elements, structure, and balance between each subsystem and between internal elements. Through the establishment of the smarter city Ecology Managementmodel's conceptual model and theoretical argumentation, it provides a theoretical basis and technical guidance to that model's innovation.

## 1.Introduction:

As the city and urbanization'saccelerated pace has caused galloping population, the urban framework is extendingwith increasingly complex social problems. The urban management tends to become complicatedand the governance seems more difficult to pursue. From this issue, exploringthe urban management's new model has attracted the local governments' urgent attention. Cities like a machine, only normal operation can make it play a good effect. The city, through the management, fully mobilizes the urban subject - people's enthusiasm and self-consciousness. The human factor isorganically combined with a variety of other things'factors, thereby promoting each system's urban normal effective operation. But the city will encounter a series of problems during the operation such as production, employment, safety, ecological environment and other



issues. It will be solved by strengthening the city's integrated management. The traditional urban management is centered on things like technology, production and other things' management, with executive order institutional constraints as leading management, but blindly seeking for the normative systems' establishment will not alleviate urban problems.

The current state smarter city management-related standards are not clear. The social management's relevant departments has the common "fragmentation", "separation" and "repeated construction" phenomenon. Faced with these problems, it urgently needs the application of a scientific theory combining with smarter city information means in the society's business management in order to effectively solve the social management problem, improve economic management efficiency, enhance public services, facilitate people's livelihood communication, increase system integration and resource sharing strength, bring into play of smart ecological construction overall effectiveness and improve work efficiency and management level. Based on ecological theory as the guiding ideology, it is proposed the urban ecology management theory and methods combination, the smarter city ecology management's conceptual model, theoretical basis and technical guidance to its innovation.

## **2. Reconstruct The Modern Urban Management Model**

### **2.1. Modern Urban Management's Problems Analysis**

People continue to pursue the urban development concept such as the smart, green, digital and eco-city, and its essence is to bring more peace and well-being into the cities, but things are not always as people imagine. With the modern cities' rapid development, the city is full of contradictions and ill-posed problem. The problem not only reduces the urban residents' life quality, but also directly affects the city's economic development, social stability and so on. Urban management model change is the only way for people to solve their problems. It is a series of activities aimed at improving the function and efficiency of urban systems. Due to various disciplines emphasizing different angles and directions, it has caused some problems. Through the traditional urban management model studies, we can see that it faces the following obvious questions.

(1) Various urban systems' uneven ecology development. Urban development has made great progress; not only enormous changes in the original city has taken place, but also a large number of new cities have undergone the rapid development just like the bamboo shoots after a spring rain. Urban planning attaches importance to physical form but neglects human nature demands which is observed in the natural environment and humanization's fusion defects (lack) which results in laying more emphasis on economic development, neglecting society and the people's livelihood, urban public facilities and infrastructure's lack, green space reduction, road congestion, environmental degradation and other discordant urban problems. Formerly in the urban planning and construction, those people more respected those breakthrough achievements at the "visible", "tangible" material and hardware level which is regarded as the smart city's fundamental signs. It has resulted in the "big engineering", "big project", "large scale" and "generous" urban planning's blind pursuit with the urban population reaching hundreds of millions and the urban nature apt to engage in "an international metropolis". People, in the high material civilization's pursuit and enjoyment, ignore the social, infrastructure and natural ecological development. Some cities even exchange for a "temporary prosperity" of the city's economy at the expense of the natural and ecological environment.

(2) Lack in urban resources' economic development

1. Various cities are similar in industrial structure, with repeated construction prevalence and a

large number of overcapacity enterprises. Whether the cities are in north or south, and regardless of their strengths, their industry structure generally has equipments manufacturing, chemicals, electronic communications and other industries, which is very similar and the similarity coefficient between some cities reaches 0.8-0.9. Great similarity between the industrial structure restricts the economic links between cities, hinders the city's economic development and also causes a vicious competition between cities. Unobvious leading industry advantage: Urban economy leading industry did not achieve the desired results and the growth brought about by the institutional changes is far greater than the leading industry growth strategy's impact. Many cities made a mistake in the leading industries choice. Tertiary industry lags behind with prominent internal structural contradiction. This not only affects the urban residents' life and improves the overall economic benefits, but also exacerbates the already severe employment situation. Urban economic innovation capability is not strong, with low economy knowledge levels. Due to the science and technology's imperfect and uneven development, not scientific and enough rational government functions and many other factors, technological development and transformation, science and technology input, technology's economical contribution, and introduction, digestion and absorption to technology, most cities are far from the smart cities' economic goal objectives requirements.

### (3) Urban society's Lower overall level

The construction of human resources is backward, due to the fact that the industrial structure of some cities is single, the urban economic foundation is weak, the labor market development is not perfect, and the social security system of workers has not been fully established. Management level and the legal system construction is not perfect, in recent years, according to the unified requirements of the central government of the city government has carried out many reforms, but the overall effect is still not obvious. Mainly in the management of large institutions, and low efficiency, more personnel than work available management methods and procedures are not scientific. At the same time in the construction of city laws and regulations on the one hand is not perfect, the law, knowingly violate the law, breach of privilege etc. on the other hand is quite prominent, provide a hotbed for corruption, and seriously affected the overall image of the city [2]. Social security system is not perfect. In recent years, the city has carried out the construction of labor insurance, unemployment insurance, medical insurance, city social security system, but in general, the coverage is not complete, the level of assistance is low, has become a key problem in city social stability and restricting the healthy development of the city society

### (4) Inadequate urban infrastructure, unreasonable internal structure

The level of urban infrastructure can not meet the needs of urban development. The city government made great efforts in city infrastructure, to some extent alleviate the serious shortage of city residents in the electricity, gas, water supply and drainage, transportation and other infrastructure of the city, but the wisdom of the city and the demand is still a big gap. Urban infrastructure investment and construction of the structure is not reasonable. The inherent law of urban infrastructure requires that all the internal systems and departments should be reasonably considered in accordance with a certain proportion of science.

### (5) The urban natural environmental protection is not seriously taken

Urban natural ecological situation is still very grim. Many cities, especially large ones, in terms of air and water quality, green space, biodiversity and urban environmental situation, are still in a worsening trend. The city's artificial environment and natural coordination are not scientific enough. Because of the urban landscape design and important buildings and structures' design and construction, the leaders make more decisions without enough emphasis on the experts and

scholars' opinions, the residents' views ignored or omitted and this results in uncoordination between urban construction's artificial and local natural environment which has led to waste. Shortage in urban resources. Due to the natural resources' uneven distribution in the city, the most prominent is lack in the drinking water resources, mineral resources, natural gas and other natural resources which is an important factor that constrains the rapid urban development.

### **3. Ecological model of smart city operations**

As for the issues existing in the traditional urban system construction and development aspects, the smart city construction and management should change the traditional urban management model and develop towards the direction more conducive to the sustainable development. Smart cities are essentially different from the traditional ones in terms of pattern, structure, function or other aspects, and the traditional urban system construction city is built on the basis of the industrial civilization and technological progress era's value concept, which is passive reaction to the various urban people's counter-industrial civilization problems, which is not enough for the smart city management development, so we must change our urban management mode, under the guidance based on ecological values and create its smart ecology's theoretical framework.

#### **3.1. Autogenesis to Symbiosis**

Facing the problems like economic, social, infrastructural, natural ecosystems that are not development coordinated, the environment deterioration, the economic growth's extensive mode, serious waste issues, the widening gap between rich and poor in the urban construction and development process, in order to achieve the overall healthy urban system development, change the traditional autogenic relationship in urban construction process, involving the city's material and spiritual aspects, both conducting organic matter updates for economic and ecological systems and infrastructure at the material level, but also build social and natural ecosystems in line with the ecological theory construction, establish a social and natural ecosystem in line with the ecological theory, build a mutual equality, harmonious symbiotic relationship between man and nature, person and person and various subsystems in the city. Various subsystems in smart city run along the co-evolution path, these subsystems are in common activation, joint adaptation and joint development cooperation and coordination in the process.

#### **3.2 Artificial Plunder into a Harmonious Balance**

Now that there are all sorts of urban problems, it is serious damage to the inner nature's harmony and urbanization's artificial predatory natural results. Although artificialization can improve the human beings viability and the urban environment's regulatory capacity but also causes destruction of the balanced relationship's various elements in the city system. Smart city-building should extend from the past human studies to the study on the human and nature balanced harmony. Therefore, the smart city construction should be based on dual existence of ecological and economic theory, improving the nature's inner harmony.

#### **3.3 Part to Overall Shift**

Holistic thinking and decision-making is the only way to realize the smarter city management. Integrity includes comprehensive grasp and balance in social, economic, natural environment and infrastructure facilities construction in urban and rural regions. Throughout the urban construction and development process, the overall progress of the society is the development's fundamental objective, economic growth and efficiency improvement is the way and means of development. Infrastructure conditions are to ensure development while protecting the natural environment condition is the foundation for reaching the overall development. In the construction process, a balance must be achieved in four areas, and no aspect is to be neglected.

### 3.4 Transition Single to Multi-objective Goals

Due to the fact that those different targets are often conflicting, economic growth ones' one-sided pursuit or environmental quality objectives are inevitably at the expense of other benefits for the price. Therefore, the smart city system construction should not be a single, separate from each other, but should be weighed in a multidimensional space. The target selection is not just one dot or aspect, but is set as a whole of dots or aspects. Table (2-1) shows the comparison results of the conventional urban construction and smarter city Ecology Managementmode.

Project	Traditional urban management model	Smarter city Ecology Managementmodel
Philosophy	Autogenic	Symbiotic collaboration
Values	Labor exploitation	Balanced and harmonious
Content goal	Single goal, the economy	More objective, complex ecosystem
Subject scope	Independent discipline	Multidisciplinary
Decision-making way	Closed, administrative intervention	Open, pluralistic participation
Management procedure	One-way,static	Cycle, dynamic
Management support means	Human manual work	IT intelligence

Table (2-1) Comparison between the conventional urban management model and smarter city Ecology Managementmodel

## 4. The concept of Intelligent City Management

### 4.1 The management mode of intelligent city from the perspective of ecology

Ecological management model is a new concept of management, it uses the basic theory of ecology and the basic point of view to observe the relationship between urban system environment. To manage the entire city ecology management system as the research object, to reveal the intrinsic relationships between the organization and the management of the ecological environment, to seek coordinated approach between the organization and management of modern ecological environment in general, is the management system integration, system and organization grasp. Smart city operation method based on the perspective of ecological theory is a new perspective to study the management of the city, it is produced in the city management mode of innovation development and further awareness of ecology, is an inevitable trend of scientific development of the city. The concept of sustainable development of 4] city and ecological city, green city, ecological city shows that the proposed management trend, showing construction ecology management mode is the inevitable further development of city management.

### 4.2 Role of Smarter city Ecology ManagementMode

Discussion on ecological management model is based on the ecology development; and its construction provides the following functions for reference:

1 provides a new concept of ecological management of organic wisdom City, the realization of the reduction of the concept of mechanical management to the organic holism of the management concept of change, laying the foundation for the ecological management of the world.

In 2 the relationship between understanding and dealing with the organization and management of city environment, the use of ecological thinking, to consider from the perspective of ecology, as the

relationship between the organization and management of the city environment is an ecological management system, is an organic whole.

3 essentially, ecology and management have internal unity, which constitutes the ideological basis of ecological management. The urban management is the management of the urban organization in essence, and the city organization is in the specific management environment. The operation of the smart city contains the ecological, organic and unified pursuit of the relationship between the urban organization and the management environment.

## 5. Ecological Management Mode's Conceptual Model

Smarter city Ecology Managementmodel is based on the fundamental information related to technology, through corresponding manners in monitoring, analysis, integration and wisdom; it synthesizes functional departments, integrates and optimizes existing resources, seeks to provide better service, green environment, harmony society and security for sustainable urban development.

### 5.1. Smarter city Ecology ManagementMode's Conceptual Model Analysis

According to the theoretical research, to provide better service, green environment, harmonious society to maintain the wisdom of the city system, to ensure sustainable development of the city, the system must realize the optimization of the structure, dynamic and open, can strengthen the control and environment adaptability, input and output to improve the conversion efficiency, through the description of the system of society with the economy, population, resources and environment, mutual adaptation mechanism, appropriate population status, adaptive capacity, environmental resources efficiency, changes in technology applicability, can evaluate the status of city management. Change of city management in the process of the interaction by external forces and internal forces, the changes may be the population migration and cultural concept, the change of industry structure, traffic form and route changes, the development of new technologies and the requirements of social life and other aspects. The goal of urban management in ecological management mode is not to optimize the development of each system in the city, but to have a certain matching relationship under certain constraints. The balance and coordination between the various elements of the city, the basic requirement is not the strength development and production activities in the city more than the ecological support system of resource regeneration and purification ability, and these goals may be affected by the system capacity constraints, in order to overcome capacity constraints, requires the implementation of a series of measures, the city system constantly the development from lower stage to higher stage.

### 5.2. Conceptual Model Representation

In accordance with the urban system development utility maximization theory and ecological management concept and according to its ecological carrying capacity theory [12], the city complex system's development characteristics are chosen to construct the smart city system's ecological management conceptual model as follows:

$$\max U = \pi_{pt} U_{pt}(t, s) + \pi_{et} U_{et}(t, s) + \pi_{rt} U_{rt}(t, s) + \pi_{ent} U_{ent}(t, s) + \pi_{it} U_{it}(t, s) \quad (4-1)$$

Constraints:

$$\text{Population Capacity Constraints } X_{pt} \leq X_p^{\max} \quad (4-2)$$

$$\text{Environmental Carrying Capacity Constraint } X_{ent} \leq X_{en}^{\max} \quad (4-3)$$

$$\text{Resources Carrying Capacity Constraints } X_{rt} \leq X_r^{\max} \quad (4-4)$$

$$\text{Intergenerational Development Constraints } U(t, s) \leq U(t+1, s) \leq U(t+2, s) \leq \dots U(t+n, s)$$

(4-5)

Inter-city Balanced Development Constraint Utility Equations  $\frac{\partial U^2}{\partial t \partial s} \geq 0$  (4-6)Utility Equation  $U_p(t, s) = f_1(x_{pts}, M_{ts})$  (4-7)

$$U_e(t, s) = f_2(x_{ets}, M_{ts}) \quad U_r(t, s) = f_2(x_{rts}, M_{ts})$$

$$U_{en}(t, s) = f_4(x_{ents}, M_{ts}) \quad U_f(t, s) = f_2(x_{fts}, M_{ts})$$

Bertalanffy Equation

$$\frac{dX_{pt}}{dt} = g_1(X_{PT}, X_{et}, X_{rt}, X_{ent}, X_{ft}, a_1); \quad (4-8)$$

$$\frac{dX_{et}}{dt} = g_1(X_{PT}, X_{et}, X_{rt}, X_{ent}, X_{ft}, a_2); \quad \frac{dX_{rt}}{dt} = g_1(X_{PT}, X_{et}, X_{rt}, X_{ent}, X_{ft}, a_3)$$

$$\frac{dX_{ent}}{dt} = g_1(X_{PT}, X_{et}, X_{rt}, X_{ent}, X_{ft}, a_4); \quad \frac{dX_{ft}}{dt} = g_1(X_{PT}, X_{et}, X_{rt}, X_{ent}, X_{ft}, a_5)$$

The model variables have the following meanings:  $t$  is the time variable, refers to the development stage;  $s$  is the space variables; it means different cities in space;  $U(t, s)$  is the  $t$ -th generation of the city's total utility value;  $U(t, s)$  is a certain city's  $t$ -th generation system elements ( $p, e, r, en, f$  respectively refer to population, economy, resources, environment and infrastructure) development utility value;  $X_{it}$  was the  $i$ -th element of the  $t$ -th generation for the developmental vector;  $M_t$  is the weight of the  $i$ -th system factor for the effectiveness of the  $t$ -th generation;  $M_t$  is the demographic variables which is a function of the population's quantity and quality, namely:

$$M_t = \beta(m_N^t, m_Q^t) \quad (4-9)$$

The objective function indicates that the SmartCity's development pursuit is the largest city overall system total utility value, the total utility value is the weighted average of the each system's utility value. As different generations' different preferences, so the number of generations is not exactly right. For example, in cities of developing countries, the economy is at the less developed stage, the weights given to the utility values' economic growth may be higher than that of other systems' effectiveness. In the city at the highly developed stage, the weights given to the environmental effect may be greater. Thus, the weight is actually a function of the levels of the system development, namely

$$\vec{\pi} \text{—Weights vector; } \vec{\pi} = (\pi_{1t}, \pi_{2t}, \pi_{3t}, \pi_{4t}, \pi_{5t}); \quad (4-10)$$

$$X_t \text{—Each system's development level vector. } X_t = (X_{pt}, X_{et}, X_{rt}, X_{ent}, X_{ft})$$

In general, demographic, social, environmental, infrastructural and cultural subsystem is an increasing function of system  $\pi_t$  at time  $t$  while the economic system  $\pi_t$  is a decreasing function of time, i.e.

$$\frac{d\pi_{ft}}{dt} > 0, \quad \frac{d\pi_{et}}{dt} < 0, \quad \frac{d\pi_{rt}}{dt} > 0, \quad \frac{d\pi_{ent}}{dt} > 0, \quad \frac{dX_{ft}}{dt} > 0$$

In formula (4-2), (4-3),  $X_p^{\max}$ ,  $X_r^{\max}$ ,  $X_{en}^{\max}$  respectively refer to smart city population capacity, resources carrying capacity and environment carrying capacity thresholds (4-4).

Intergenerational development constraints means that the future generations' total utility is at least



not less than the contemporary generation's one. Intercity development constraints take a meaning that each city's subsystem development does not undermine the other cities' overall effectiveness.

Utility equation represents the various subsystems' utility, which is a function of each subsystem's development level and the demographic variables. Bertalanffy relationship equation indicates that in the smart city systems under ecology management mode, any change in one element is relevant with the levels of other relevant factors' development and leading to changes in them and changes in the whole system, thereby reflecting holistic thinking of the ecological theory.

## 6. Conclusion:

Smart safe ecological mode concept acts as an example of innovative approaches to urban management, which is not perfect, but realizes the reflection of the application value of smarter city management methods, including the overall building ideas. Based on the conceptual model, smarter city Ecology Management mode's definition, analysis, research and demonstration, it suggests that smart city ecology management model is a multi-dimensional aspect with a stage characteristics and regional differences, and it requires the coordinated development and overall improvement of the various parts in the smarter city management. Here we can give some examples of this aspect, namely the improvement of the overall urban management's level. While managing potential, it also gets further improvement to the city's management coordination and the smarter city management process is demonstrated to be volatile. It believes that each system, in case that it does not exceed the threshold, has the substitutability between various management indicators. It emphasizes on the smart city management integrity, believing that the urban system optimization is based on that of the various subsystems, thus calling attention to the balance of the internal components and the structure within those subsystems. Smart City Ecology Management Model integrates the urban resources to achieve the city administration changing from "extensive management" to "fine-based management" in order to better safeguard the urban social order, promote economic development and improve the human life quality.

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