STUDY ON THE SYSTEM OF TECHNICAL METHODS
FOR DIGITAL URBAN PLANNING

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ABSTRACT:

Along with the development of Digital City, traditional urban planning is surely going to be developed to Digital Urban Planning. But there is no authoritative definition of Digital Urban Planning till now. Therefore, the essential concept of Digital Urban Planning was defined in this paper at the beginning. Based on the concept, the two main contents of Digital Urban Planning, such as physical and social planning, and technical and information planning, were discussed briefly. According to the concept and contents, the system of technological methods was discussed for Digital Urban Planning. Then, most of the technological methods were addressed by means of information acquisition, information process, and information expression. Finally, some conclusions related to Digital Urban Planning were summarized.

1. INTRODUCTION

Digital City is the most popular term in China. Both the scholars and officials pay more attention to the research and construction of Digital City. Most of the cities have been involved into some kinds of Digital City development project. Some of them are constructing city information infrastructure, while others are developing city spatial data infrastructure and management system. City information center or information harbor has been established for Digital City services. There is no doubt that in the near future, many Digital Cities will be constructed based on the city information infrastructure and spatial data infrastructure.

In the future Digital City, most or all the spatial and attribute information will be managed by city information center based on distributed database management system. Many kinds of application management systems will be applied in different official departments. Even the ordinary people can access the information by means of network and support their daily activities which include the work, study, and live. Therefore, the current urban planner must facing the challenge of using new technology to do urban planning based on the digital city(Dangl, 2002), which can be expressed as Digital Urban Planning.
However, how to do the future Digital Urban Planning with digital city? What kind of technology need to be applied and how to apply? What is the relationship between the current tradition urban planning and future digital urban planning? All these questions need to be studied at the very beginning. This paper focused the questions and discussed three main issues, such as the concept, the contents, and technical methods of digital urban planning.

2. CONCEPT OF DIGITAL URBAN PLANNING

2.1 Literature Reviewing

Based on the interview of related literature, the item of Digital Urban Planning was first come up with the development of Digital City in later 2000. Professor Lai Ming, who is one of the officials of the Ministry of China Construction, pointed out that Digital City supplied totally new way to solve the issues of urban planning, managing, constructing, and controlling (Lai, 2000). At the same time, Professor Ding Lieyun said that the concept and method of urban planning need to be changed along with the development of digital city (Ding, 2000). These ideas are really the basic viewpoints for the appearance of Digital Urban Planning.

Two months later, professor Jian Fengmin published a paper titled "from digital earth to digital urban planning (Jian, 2000). This is the first appearance of Digital Urban Planning in due form. And at the same time, professor Jian explained that the item of digital urban planning means to describe the past, current, and future spatial shape of city by combining city economical, social, and population information together based on digital map (Jian, 2000). Obviously, from today's point of view, the concept of digital urban planning worked out by professor Jian is not exact and enough.

The fact is that the concept has been developed during the past five years, from 2000 to 2005. In 2001, professor Wu Shuxia said that digital urban planning was the combination of theory and method of traditional urban planning with new technology in the new digital city period. The concept of digital urban planning is not only the technology, but also the quantitative

theory and method of urban planning (Wu, 2001). Later, some others used the item of digital urban planning in their study papers or publications, but it was not always the same meaning (Liu, 2003; Wang, 2003; Yu, 2004; Cui, 2005). Sometimes it refers to urban planning information system, and some times refers to urban planning technology.

The following tree points are the conclusions of literature reviewing. First is that the item of digital urban planning is related to digital city. Second is that each scholar described one aspect of the concept of digital urban planning. Third is that there is no common definition of digital urban planning.

2.2 Definition of Digital Urban Planning

Supported by the Basal Research Fund of Tsinghua University, the theory and method of digital urban planning were studied. Based on the literature reviewing and our study on digital city, tradition urban planning, and digital urban planning, the definition of digital urban planning was worked out as follows. Digital Urban Planning is a new kind of urban planning based on information infrastructure, spatial data infrastructure, and planning and managing system of digital city. During the process of digital urban planning, all the basic materials of the city are digital information. The purpose of digital urban planning is to determine the development goals, urban land use, urban spatial pattern, information infrastructure, spatial data infrastructure, and other integrated construction project of both realistic city and digital city.

Two key-points need to be considered in the definition of digital urban planning. One is that digital urban planning is related to digital city. All the planning process is based on digital city system, which includes information infrastructure, spatial data infrastructure, planning and managing system of digital city. And during the whole planning process, digital information will be the agent object which makes digital urban planning is different from traditional urban planning in all the aspects of technical method application, information processing procedure, and results expression style. The second key-point is that the purpose of digital urban planning determines its contents, which not only include the physical and social planning related to realistic city, but also include technical and information planning related to digital city. Therefore, digital urban planning is really refers to the future urban planning based on the digital city. And those current urban planning which use some kinds of technology, such as GIS and CAD, partially based on digital map, and only for physical planning is not belong to digital urban planning.

According to the definition of the digital urban planning, the difference and relationship between current traditional urban planning and future digital urban planning can be explained as two sides. The difference is that digital urban planning will pay more attention to digital city by using digital information and related analysis model and technical methods. The main contents of digital urban planning include physical and social planning, as well as technical and information planning. And the results will be mostly expressed by digital document, digital map, and virtual reality model. The relationship is that, similarly to current traditional urban planning, digital urban planning will include Master Digital Urban Planning, District Digital Urban Planning, and Detailed Digital Urban Planning (which includes Digital Regulatory Plan and Digital Site Plan) based on the space size of city and planning purpose.

3. CONTENTS OF DIGITAL URBAN PLANNING

From the definition above, the contents of digital urban planning can be deduced as two aspects. One is Physical and Social Planning which is pay more attention to the realistic city, while the other is Technical and Information Planning which is mostly concern to digital city (refer to Fig. 1).
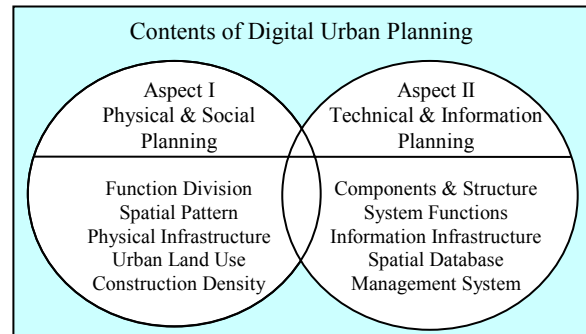

Figure 1. Contents of Digital Urban Planning

3.1 Physical and Social Planning

The contents of physical and social planning of digital urban planning should not only include the whole contents of current urban planning based on the *"Procedure of Urban Planning"* (The Ministry of China Construction, 1991) and the *"Detailed Implementation Process of Urban Planning"* (The Ministry of China Construction, 1995), but also need to be expanded according to the development of digital city.

Taking master digital urban planning as an example, the physical and social planning contents should include at least six aspects, such as determining essential character, development goals, spatial scales, urban land use, spatial distribution, and all the physical infrastructure of realistic city. Besides that, because of the development of digital city, some issues related to material flow, energy flow, population flow, and information flow need to be taken into account at the same time. The producing and consuming activities of citizens and the living and behaviour mode of citizens are all will be changed. And all the changing will affect the physical and social planning of digital urban planning, which need to be studied in detail.

3.2 Technical and Information Planning

The contents of technical and information planning are related to and focused on the digital city. Basically, the technical and information planning should depend on the existing status and development trends of digital city. The development of spatial information technology, computer science, internet technology, digital communication technology, and database management technology are all need to be considered during the digital urban planning process. At one time, the economical strength of the realistic city and the demands of digital city development must be taken into account. The master goals, scales, structures, components, and functions of digital city need to be planed in general, which include the information infrastructure, spatial data infrastructure, and many application management system of digital city. And some of the implementary measures need to be planed in detail.

Similarly, taking master digital urban planning as an example, the technical and information planning contents should include at least following nine aspects. (1) Master goals of digital city development and construction. (2) Components and structure of digital city system. (3) The tasks of each construction stages and investment scales. (4) The goals and tasks of city information infrastructure. (5) The general constitutes and structure of city information infrastructure. (6) The goals and tasks of city spatial data infrastructure. (7) The general constitutes and structure of city spatial data infrastructure. (8) The goals and tasks of urban planning and managing information system. (9) The general constitutes and structure of urban planning and managing information system.

4. TECHNOLOGY OF DIGITAL URBAN PLANNING

Determined by the characteristics of digital city and concept of digital urban planning, the whole process of digital urban planning can be divided into three periods. Illustrated by figure 2, the three periods are planning information preparing, planning scheme compiling, and planning result expressing. Many kinds of technologies need to be applied during the whole planning process, and each period involves different technology. Digital information and spatial database play an important role. And all the planning process are supported by digital city technological platform, which is the main difference between traditional urban planning and digital urban planning.
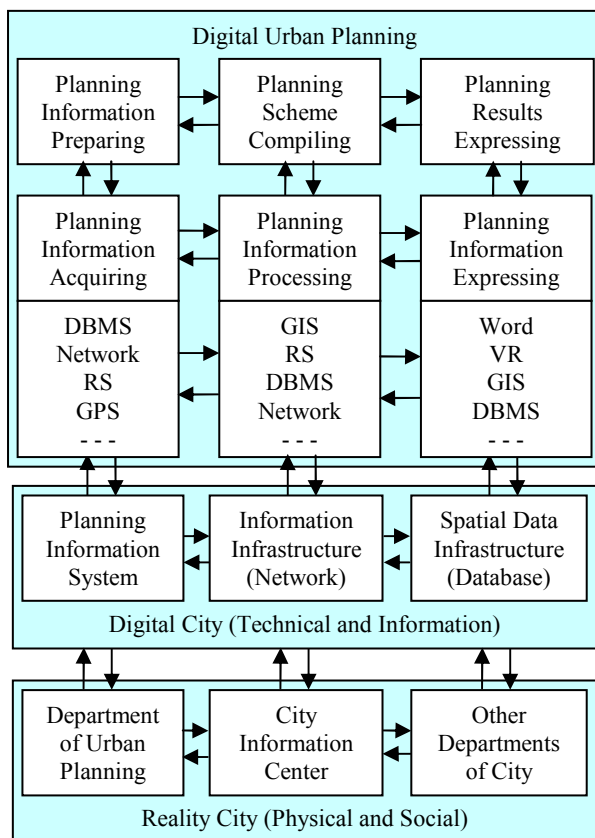

Figure 2. Technical Process of Digital Urban Planning

Comparing to the traditional urban planning, the technical process of digital urban planning is much more complex. The relationship between each period is not just linear but network,

which is not only very good at the feedback and circulating for the tentative planning scheme, and also very helpful for evaluation and optimization of final planning scheme. Further more, the technical method, analysis process, and information category are much more complex during the process of digital urban planning. Lots of technologies, such as Remote Sensing (RS), Data Base Management System (DBMS), Geographic Information System (GIS), Virtual Reality (VR), and Computer Network will be applied widely. The whole technologies consist of a system of technical methods for digital urban planning. All the technologies can be divided into three categories, such as technology of planning information acquiring, information processing, and information expressing.

4.1 Planning Information Acquiring

There are two main tasks for planning information acquiring. One task is to acquire all kinds of existing information for urban planning by means of urban planning and managing information system supported by information infrastructure and spatial data infrastructure of digital city. All the information, such as city natural resources information, city social and economical information, and city construction information, are need to be acquired and collected for later use. Besides, some kinds of field investigation are also needed because of the high speed of city development.

Another task of information acquiring period is to transfer all the information into the same system. Regarding to the different sources of the original information, the differences between the information are always in existence, such as different type, different format, different time, different coordinates, and different semanteme. Therefore, all the information acquired needs to be transferred by means of different technical methods. Among all the technical methods, DBMS and computer network are the very basic technologies for planning information acquiring. The functions of DBMS querying and searching operation by network will be used very frequently. Other spatial information acquisition technologies, such as RS, GPS and GIS will be used for spatial information updating. And other new technology for collecting field information will be applied too.

4.2 Planning Information Processing

Planning information processing is the key procedure for digital urban planning. The processing will include spatial information processing, such as overlay analysis, network analysis, and three-dimensional analysis, and attribute information processing, such as population forecast analysis, economical information analysis, and energy consumption analysis. All the analysis will be finished based on the current urban planning database which is prepared during the planning information acquiring.
The result of the planning information processing is the primary planning scheme. The primary planning scheme should be send to public by means of web-based public participation GIS to collect the public evaluation. And at the same time, the planners need to evaluate their primary planning scheme by means of some quantitative analysis technical method. The third way is to present the primary planning scheme to urban planning expert and urban managers to collect their evaluation, in order to improve primary planning scheme and obtain the final optimal planning scheme.

During the information processing period, most important technical method is GIS because of its plentiful spatial analysis functions. RS technique is applied for raster image processing

and to evaluate the practical character. The DMBS and network technical method are the very basic supporting techniques of planning information process for digital urban planning. Some other technical methods, especially forecasting analysis method are used for information processing too.

4.3 Planning Information Expressing

Planning information expressing here means two aspects. While one is the contents of planning results, and another one is the expression of planning information. As you know, the planning results of traditional urban planning are for physical and social planning, and there are only two ways to express, such as planning documents and planning maps. Whereas the planning results of digital urban planning are not only for physical and social, but also for technical and information. Ant the results will be expressed in many different ways related to digital city technology, such as digital planning document, digital planning maps, planning information database, and three dimensional VR models. It is not only technical intensive, but also very helpful for planning implementation and management.

The techniques to support planning information expression include digital document processing technology like word and digital map producing. Besides that, the three dimensional visualization techniques like VR will be widely used for expressing digital urban planning results. And the planning information database will be the new input of city spatial data infrastructure supported by DBMS technology. Meanwhile, the planning results will be released widely by means of network based on web-GIS.

5. CONCLUSIONS

To sum up this research, four conclusions were worked out. First one is that the digital urban planning is the future urban planning along with the development of digital city. Second one is that digital urban planning is a newly urban planning for digital city supported by information infrastructure, spatial data infrastructure, and urban planning and managing information system of digital city. Third one is the content of digital urban planning, which includes two aspects -- physical and social planning for realistic city, and technical and information planning for digital city. Fourth one is the system of technical methods for digital urban planning, which is consisted of three categories, planning information acquisition technical method, planning information process technical method, and planning information expression technical method.

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