

## Scientific Engineering of Digital Earth

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**ABSTRACT** ‘Digital Earth’ is a great scientific system which integrated science with technology and engineering. “Digital Earth” is composed of basic research, technology supporting and scientific engineering. The core and the aim are the scientific engineering. In the last of this paper, some suggestions for developing scientific engineering of the ‘Digital Earth’ of China are discussed.

**KEYWORD** Scientific System, Scientific Engineering, Digital Earth

Chinese government and scientists have paid high attention to the “Digital Earth”. Before we discuss the development strategy, and research in the field, we should understand the concept of the “Digital Earth” wholly and clearly.

### 1. Scientific System of ‘Digital Earth’

Integrating Geo-sciences, information sciences, computer sciences, space surveying and digital communication, ‘Digital Earth’ is a great scientific system which aims at promoting the sustainable development of global in the next century by engineering and industrialization. The core and the duty of the ‘Digital Earth’ is to construct a performable WebGIS.

The scientific system of ‘Digital Earth’ consists of three parts. They are basic research, technology system and scientific engineering. Taking the global as the study object, basic research of the ‘Digital Earth’ is to build the physical model, mathematical model, information model and computer model of the earth and geographical phenomena. The technology system is composed of data capturing, transforming, storage, processing and display, etc. The technology system of ‘Digital Earth’ of China must fit for its conditions. Satellite and plane are the components of the data capturing system, which support the differential applications and scale research. Besides, it should include wide network for data transportation, supercomputer, simulating and virtual reality. The scientific engineering of ‘Digital Earth’ is to build a performable spatial information system in the network. The core of the ‘Digital Earth’ is the scientific engineering.

### 2. Scientific Engineering of ‘Digital Earth’

The scientific engineering of ‘Digital Earth’ carries both the basic research and the national economy step forward. All of the four potential applications and five future application fields giving by Vice President AL Gore are scientific engineering. That is to say the way to achieve the ‘Digital Earth’ is the

scientific engineering.

#### 2.1. Inheritance and Development

‘Digital Earth’ is the result of the inheritance and development of both the spatial technology from the RS, GIS, GPS, ES to Geoinformatics and information science from LAN, internet to information super highway of global.

What we say in the above is not mean that it does not need innovation. We mean that our work should based on the reality, based on our long-term works.

#### 2.2. Science Engineering

‘Digital Earth’ scientific engineering, combining the science with engineering, has more innovating and exploring than general engineering. The key procedures to implement the scientific engineering should include ①design — design the aim of the engineering, ②research — research on the principle and implement methods of the ‘Digital Earth’, ③develop — solve the problems in the applications, ④engineering design — submit optimization engineering schema, ⑤construct — prepare the material and the hardware and software, ⑥product — fix on the process flow, production test and quality control, ⑦manipulating — run the method and system, ⑧system management and ⑨person training. The nine steps differ the scientific engineering with the basic research.

#### 2.3. Starting and Development

The development of scientific engineering of the ‘Digital Earth’ can be divided into 3 period. They are the starting period, developing period and growing up period (fig.1).

##### ① Starting Period — Integrating

Many information systems of set up during the ‘eighth-five’ and ‘ninth-five’ at varying level for each field are the strong foundation of the starting. But these information systems are not equal to the

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functions of the distributed information systems.

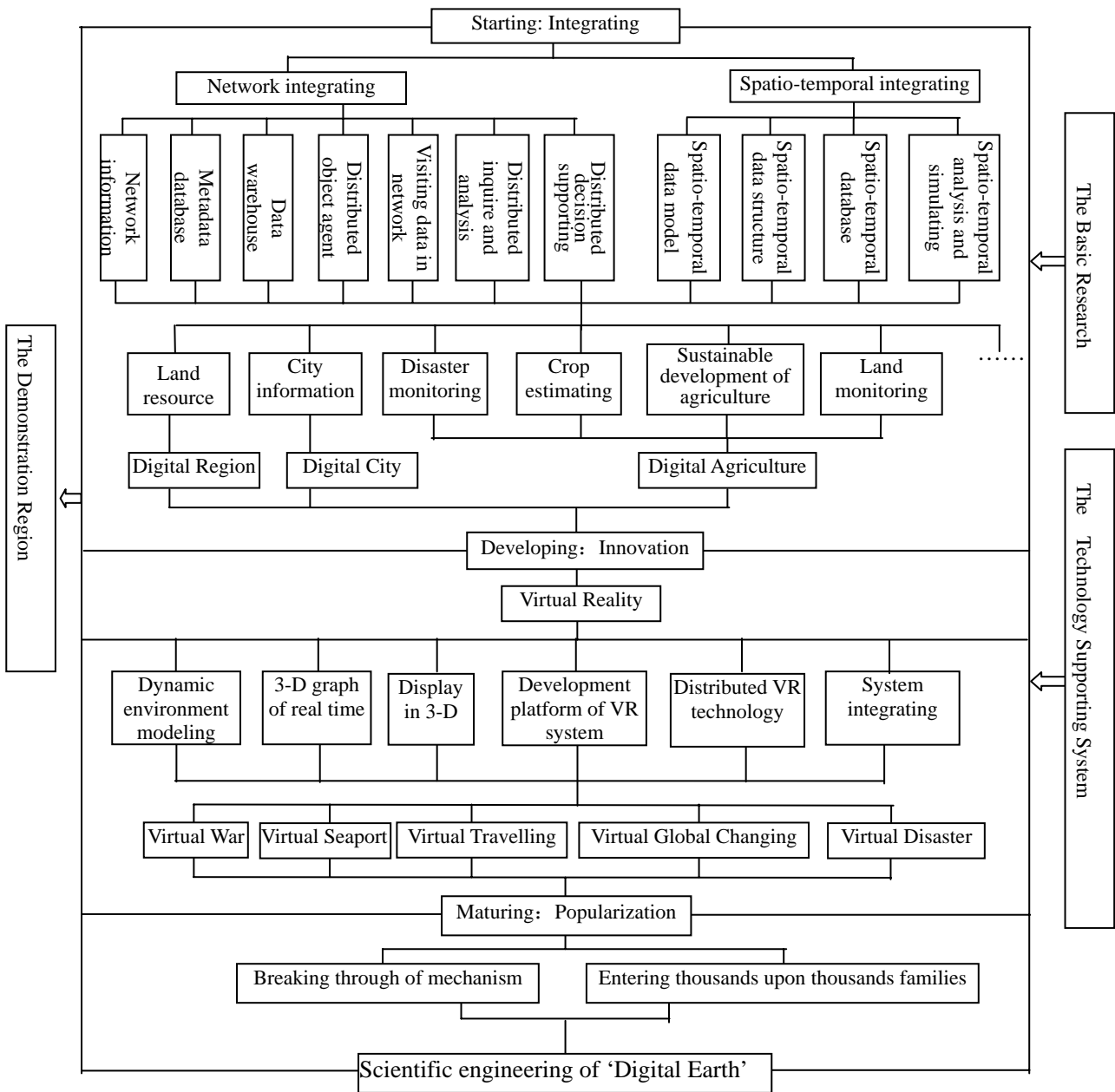


fig.1 Development of the Scientific engineering of "Digital Earth"

Earth', They need to be reconstructed. Integrating is the core of this extending work and it includes both the network integrating and spatio-temporal integrating.

Network is essential to the 'Digital Earth'. Network integrating means building the web site and spatial data warehouse system, implementing dynamic visiting, inquiring, analyzing and decision, setting up metadata and the information standards for information sharing in order to made all the information systems running in the network environment. At present, few information systems are built upon the network and they do not have the

Two dimensions or 2.5 dimensions is the basic characteristic of the traditional information systems.

Time has the same important role as the space in the 'Digital Earth'. Only when we have the spatio-temporal database, can we analyze in spatio-temporal dimension and realize the spatio-temporal simulating in the 'Digital Earth'.

② Development Period — Innovation

When we have made great progresses on the technology field, for example, wide frequency of the internet and the large scale memory reaching 1015 information unit, and RS image with 1m resolution

or new effective and exact RS data capturing system of all around, then we enter the development period.

The sign of the scientific engineering of 'Digital Earth' is the virtual reality. The virtual technology will drive those practical engineering, such as the virtual disaster, virtual war and 'Digital China', etc. The virtual technology includes the large amount of the data storing, fast data processing and wide frequency information channels.

Innovation will in the all procedures of the scientific engineering because the foundation of the traditional information engineering, such as the database system and the model system or part of them are not fit for the new technology system.

### ③ Growing Up Period ——Popularization

When the basic research has made great progresses and the new generation of the network enter thousands upon thousands families, the scientific engineering of 'Digital Earth' reaches its mature. The sign of this period is the popularization.

## 3 Suggestions of Developing Scientific Engineering of 'Digital Earth'

### 3.1. Radiating by Demonstration

The radiating strategy by demonstration is to prompt developing in a region or part of it by both the experiment and demonstration of the scientific engineering. The object of the demonstration must suit the national development strategy, such as agriculture development, environment protection and city construction.

### 3.2. Information Sharing

Information sharing is the key to set up a performable scientific engineering. To reach the goal sharing, two problems will be solved firstly. One is the data standard, especially the metadata normalization. The other is the data sharing policy under the protecting of knowledge property right in order to solve the department monopolization and unfair charge of the data.

### 3.3. Multicomponent economy supporting

The economy of China has become the multicomponent system. The scientific engineering of 'Digital Earth' should be supported both by the country and the knowledge innovation and by other economy component because the regional government, department and industry has shown very strong interesting to it. We should develop the scientific engineering of the 'Digital Earth' by using the multicomponent economy system.

### 3.4. Set Up The Base of Industry

The scientific engineering of the 'Digital Earth' is not only the foreland of the science and technology but also the new information industry. When we construct the scientific engineering, we should set up a base of the industry for system running normally and providing technology serve for the great amount users.

### 3.5. The Priority Projects

At present, We should select some important projects to propel the scientific engineering.

#### ① Digital Agriculture

It is urgent to set up the 'Digital Agriculture' for carrying out the policy which spreading the new science and technology in the agriculture fields to turn the traditional agriculture into modern agriculture and turn the extensive management into the intensive management. The selecting of the breakthrough point and the demonstration region is important. It should be build upon the agriculture information systems set up in the past years.

#### ② Digital Transportation

Transportation is the one of the lifeline of all country. The integrating technology, GPS, GIS, RS and ES, will prompt the digital transportation and the safe monitoring, intelligent leading system for car in the city.

#### ③ Digital City

City is the most development region. It is so complicated that it needs a new tool, 'Digital City', to construct and manage the city.

#### ④ Disaster Monitoring and Predicting

Disaster monitoring and predicting is very important to our country. Monitoring by Remote Sensing is an in being technology. In order to implement the dynamic monitoring and predicting, we need the supporting of the scientific engineering of the 'Digital Earth'

Besides, the protection and management of the environment is also the important object of the scientific engineering.

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