Application of Digital Earth and Sustainable Development of Mining Area

P.J. Du Y.H. Sheng D.Z. GUO

Institute of surveying and spatial information engineering,
China University of Mining & Technology
Xuzhou City, Jiangsu Province, P.R.China 221008
Tel: 86-516-3885988 E-mail: dupj@cumt.edu.cn

ABSTRACT The proposal of "Digital Earth" is significant to sustainable development(both global and regional sustainable development). From regional aspects, Digital Earth will be the fundamental supporting technology and tool to decision-making. Mining area is a kind of special geographic area, and sustainable development of mining area should be based on accurate, dependable and comprehensive information (information infrastructure). Digital Earth can play this role as soon as it is established and applied. For mining areas and mining industrial cities, Digital Earth will be applied to regional plan, management and decision-making support widely. This paper introduces the general concept of Digital Earth, discusses the relation between information and sustainable development of mining area, and then proposes the sustainable development decision-making model of mining area based on Digital Earth. With the progress of studies and establishment of Digital Earth, it will play more and more important roles to sustainable development of mining area, and there is much work to do further.

KEY WORDS Digital Earth (DE), Sustainable development (SD), Mining area, information

1. Introduction

Earth System Science(ESS) is scientific basis of sustainable development strategy. Sustainable development can be studied by global and regional scales. Adjustment, control, and optimization of energy flow, material flow and information flow is important access to sustain-able development, of those the most important is to play the dominant roles of information flow to regional sustainable development planning, decision-making and management. DE has become the fundamental studying approach of ESS and gained wide attention in technological circles, political circles and academia, and then become the essential sustaining technology and technical support to sustainable development. Mining area is a kind of special geographic region based on resources exploiting. It is faced with serious problems on resource, environment, economy and developm-ent. With the transform-ation form surveying and mapping science to Geomatics and implementa-tion of sustainable development, multi-source, multi-resolution, mu-ltiscale, multi-field and multi-dimensional information should be applied to studies and implementation on sustainable development of mining area, so as to resource exploiting can be optimized, environmental protection be strength-ened, regional managem-ent be promoted and economic development be accelerated. The proposal and establishment of Digital Earth will provide fire-new, true 3D and visual digital decisionmaking, planning and managing platfo-rm to sustainable development of mining area.

2. Digital Earth: Concept, Establishment and Application

The concept of Digital Earth is firstly proposed by AL Gore in his speech——The Digital Earth: understanding our planet in the 21st century on January 31, 1998, and has gained comprehe-nsive attention of technological circles, political circles and academia.

What is "Digital Earth"? Generally speaking, It can input the information about earth and activities on earth, spatio-temporal changes of earth and regional environment to large-capacity and highspeed computer by digital methods to realize the circulation and observ-ation on network, and then serve for human work, study, life, amusement and sustainable develop-ment. Strictly speaking, it gives multi-resolution, multiscale, multi-spatio-temporal and multi-type description to huge-capacity geographic information based on computer, multimedia and large-scale storage technology with broad and high-speed information network as tache, and serves human beings.

The Key techniques of establishing Digital Earth mainly include: (1) earth-observing network consists of serial satellite including Tiros, land resource satellite, communication satellite and others, (2) broad and high-speed information network, WWW and Internet plan, (3) high-powered super-computer and relative software, (4) national land, resources and environmental database with 1m and more high spatial resolution, (5) 3D visualization and VR technique, and (6) applied model of Digital Earth.

The proposal of Digital Earth is both a great challenge and important opportunity to Geo-science

field and information industry. We should take this chance to lead the promotion of Earth science, Information science and industry with the strategical goal of Chinese Digital Earth or Digital China. The key issues are: (1) drawing uniform plan of spatial observation to earth, (2) improving commutation infrastructure, (3) promoting the building of National Spatial Data Infrastructure(NSDI), and (4) popularizing GIS and unify the criterion and standard of Geo-information.

Establishment of Digital Earth is significant from social development to human life, and it can be used in multi-field and multi-direction from global sustainable development, regional development planning to personal tourist plan and Electronic Commerce(EC). The more important applications will be realized in global environmental change, global and regional sustainable development, Geo-science studying, global information share, international cooperation, national and urban plan, land use plan, and so on.

The kernel contents of sustainable develop-ment include: (1) protecting and rebuilding ecological environment, (2) reasonable and sustainable utilization of natural resources, (3) implementing fair development between different regions. The key is plan, management and decision-making. Digital Earth can organize regional resource, environmental, economic, social, and all other information in computer and network by digital manner and provide inform-ation network and DSS to global and regional sustainable development. So sustainable devel-opment strategy should be based on Digital Earth and relative techniques.

3. Information and Sustainable Development of Mining Area

Sustainable development demands adjustment, control and optimization of material flow, energy flow and information flow. With the advent of Information Age, information will become basis of regional management, plan and decision-making, and knowledge and innovation will become motivity of economic development. Mining production and mining area management all involve information about resource, environ-ment, industry, economy, society and other fields. Just as urban plan originates from information, sustainable development of mining area will be determined by the capture, use, share of information.

3.1. Main Issues Affecting Sustainable Development of Mining Areas

From relative studying achievements about sustainable development of mining area, the main issues affecting sustainable development of mining area are: (1) resource exhausting and wasting, (2)environmental pollution and ecological damage, (3) single economic structure and shortage of developing potential,(4) backward technical support, (5) backward managing and decision-making system.

In all these issues, some common problems are: (1) shortage of credible and current information, (2) low using rate and level of information, (3) lagging information organizing and managing techniques. As a result, information can't be collected and used as fundamental decision-making and managing support, which leads to unreasonable and backward, even unfeasible and mistaken decision. In the implementation of sustainable development strategy, information must be paid more attention and comprehensive, credible information should be used in planning, decision-making and management, and connected with sustainable development model to realize studies on sustainable development based on information.

3.2. Functions of Information to Sustainable Development of Mining Area

The multi-source, multi-field information can be organized and managed by information system, that is Mine GIS——the basis of Digital Earth. Based on MGIS or Digital Earth, information will play fundamental, leading roles in sustainable development of mining area. That can be expressed

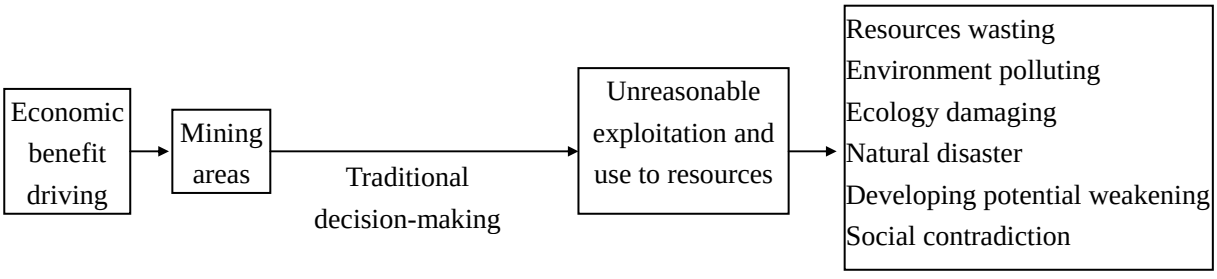

Fig.1 Traditional decision-making model of mining area

as follows: (1) multi-dimensional, dynamic, real-time and visual description and management of mining production and mining area management, (2) providing basis and reference to assessment, management and plan of mining production and mining area, (3) providing technical support to sustainable development decision-making, (4) supervising and harmonize the exerting process of sustainable development and give 3D visual model analysis, and (5) setting up sustainable development information model and information system to provide DSS.

Digital Earth is most direct and convenient expressing and applying media of information, so it will play important and fundamental roles in sustainable development of mining area.

4. Sustainable Development Decision-Making Model of Mining Area Based on Digital Earth

The key of sustainable development is planning and decision-making. For mining areas, the main contents include reasonable resource exploiting scheme, comprehensive environmental protection and treatmen[illegible]str[illegible] structure and economic developing approach, systematic infrastructure building, scientific regional plan and management. The establishment of mining area sustainable development decision making model based on Digital Earth is basis of scientific and reasonable plan and decision-making by applying modern information science technologies with the support of information infrastructure, and that is the key sustainable development of mining area.

4.1sustainable Development Decision-Making Model Of Mining Area And Information Infrastructure

Traditional producing, managing and decision-making models of mining area pay more attention to economic benefits, and intensive use of resource, ecological environmental protection is ignored. As a result, resource wasting, environmental pollution, ecology damaging, natural disaster and social problems are caused, so regional economy developing potential is weakened. Fig.1 is traditional decision-making model.

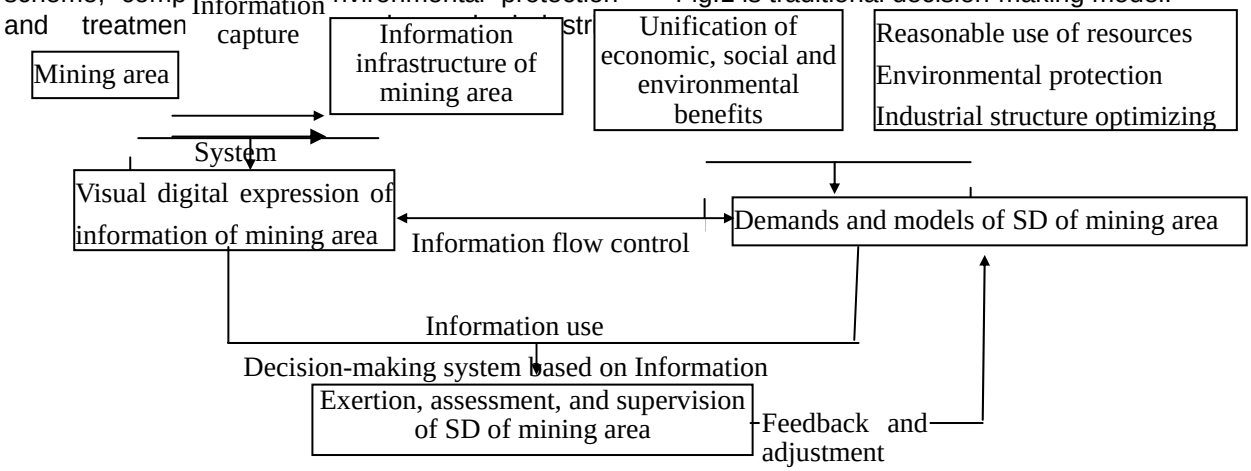

Fig.2 Decision-making model based on information infrastructure and sustainable development

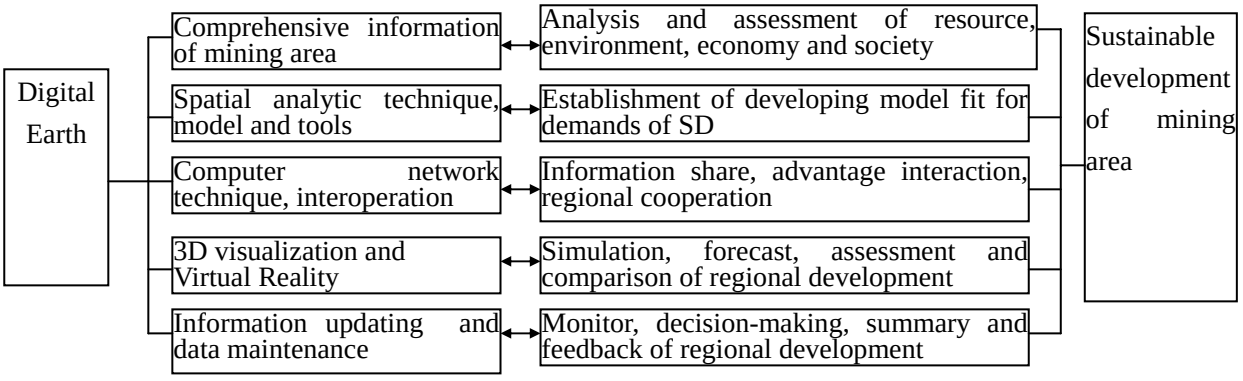

Fig.3 Sustainable development decision-making model of mining areas based on Digital Earth

With the implementation of sustainable develop-ment, regional plan and decision-making must take unification of economic, social and ecological environmental benefits as goal and harmonizing of Population, Resource, Environ-ment and Development(PRED) as principles, use multi-source, multi-dimensional information fully to provide decision-making support by infor-mation capture, feedback, adjustment, control, optimization and application of information sys-tem, and then establish DSS based on information. Fig.2 is the decision-making model based on information infrastructure and sustain-able development.

From Fig.2 we can know that decision-making model for sustainable development of miningarea must be based on full use of information area must be based on full use of information infrastructure, which is Digital Earth under construction.

4.2.Sustainable Development Decision-Making Model of Mining Areas Based on Digital Earth

The fundamental task of modern surveying and mapping science, that is Geomatics, is to estab-lish national spatial data infrastructure(NSDI). Digital Earth can be established by seamless connection and conformity of NSDI and socioeconomic information with support of 3D visual technique, spatial analytic techniques, high-speed broad network and modern computer hardware and software based on NSDI. The decision-making model for sustainable development must be based on information infrastructure of mining area, which can be described by Digital Earth. Fig.3 is the sustainable development decision-making model of mining areas based on Digital Earth.

5 Conclusions

From the studies in this paper, we can draw the following conclusions:

(1)The establishment of Digital Earth is a complex system engineering, and it has wide applications.

(2)Information will become the basis of sustainable development decision-making and regional plan and management, and Digital Earth will be the most efficient media of information expressing and applying.

(3)Digital Earth will be the fundamental technical support to sustainable development of mining area.

(4)Sustainable development decision-making model of mining area based on Digital Earth should be paid more attention.

As soon as being proposed, Digital Earth has got more and more attention, especially in sustainable development field. In this paper we discuss some issues about Digital Earth and sustainable development of mining area (a kind of special geographic region). With the comprehensive studies and establishment of Digital Earth, it will play more and more important roles in regional sustainable development. But because Digital Earth is a new concept and system, there are many key problems should be solved and much work be done. Digital Earth exhibits a beautiful prospects and we must take the chance to promote the establishment and applications of Digital Earth.

References

Cui W. 1999. Digital Earth. China Environmental Science Press.

Chen Sh. 1999. Hundreds Questions about Digital Earth. Science Press

Huang B. 1996. Earth System Science and Scientific Basis of Sustainable Development Strategy. Acta Geographica Sinica. 1996(4)

Xu G. 1996. Remote Sensing Information Science: Progress and Prospect. Acta Geographica Sinica. 1996(5)

Chen Sh. 1996. Earth System Science and Geoinformatics. Geographic Research.1996(2)