Trilateral Seminar on Science, Society and the Internet

Section III: Contributed Papers

Access to Scientific Data in China: The Current States, Barriers and Proposals for Improving the Mechanism

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Scientific data refer to the original factual and basic data in the activities of science and technology, which are transmitted by reservation records, charts, research reports, academic papers and databases, are the chief strategic resources for both the national science and technology innovation and sustainable development. The access to scientific data is essential for supporting the innovation of the national science and technology. Although evidence suggests an obvious gap in science and technology research between China and those developed countries, Chinese scientists are making painstaking efforts to explore all sorts of domains-in the fields such as life science, information science, new material, environment science, astronomy and geography– to make contribution to the sustainable development of our planet. As a developing country, access to scientific data is of prominent significance in China. In this dissertation, I'd like to determine what hampers the access to scientific data on the basis of describing and analyzing the characteristics of access mechanism, and suggest more effective measures to improve public access to scientific data in China and thus to provide consultative proposals for the construction of the scientific data platform and public access in China.

I. Characteristics of Mechanism for Access to Scientific Data in China

Scientific data in China are mainly derived from the government departments and relevant research funded by the government. For fifty years or so, a huge number of scientific data have been obtained in China by developing many scientific causes of the public good, in fields such as geological prospecting, meteorological observation, ocean observation, hydrological observation, environmental monitoring and seismological surveillance. Especially in the most recent 20 years, about 5,000 databases have been established.[1] In aspects of collecting and accumulating basic scientific data, at present, the main organizations in China are the state-owned scientific institutes with government financial assistance, including various information centers of the relevant

[1] Zhang Jingyong. 2002.China will Implement Scientific Data Sharing Project, *Public Science and Technology Newspaper*, December, 2002 (5)

departments, institutes of China's Academy of Sciences, laboratories and information centers in universities administrated by the Ministry of Education, and research institutions of other national departments and committees. Private sector or commercial units produce few data.

Information Centers of Government Departments. Most of the departments of the Chinese government have established information or data centers relevant to the respective business. Though the function of these centers is different, all of them create or provide data services. Let me cite some examples as follows:

China National Chemical Information Center (CNCIC). Set up in October 1992, CNCIC is a comprehensive information research, information service and computer application technology development center for China's chemical industry. It is a branch of the National Engineering & Technology Library and also the exhibition and exchange center, the audio/video publishing center, and energy conservation center of the chemical industry sector.

CNCIC owns nearly 200,000 books and documents, and subscribes to more than 2,000 journals in Chinese and foreign languages. The Center is equipped with advanced computers and network installations. A highly qualified research body composed of over 200 competent professionals covering all disciplines of the chemical industry, among whom there are over 100 advanced researchers and experts, has long been engaged in the trace, research and analysis of development trends, industrial movements and scientific and technological advancement in the chemical industry at home and abroad and provides a variety of research reports. The Center edits and publishes more than 10 periodicals, materials on special topics and restricted publications. It runs over ten well-known chemical websites in China and has built more than 50 databases for e-business service.

In order to meet the requirement of the market-oriented economy to the information industry, CNCIC has enforced the reform on mechanism and has set up four joint ventures or Center-share-holding hi-tech enterprises in succession including CNCIC CHEMDATA Co., Ltd., C&P Co., Ltd., CCCOI Network Technology Co., Ltd. and HKD Computer Application Technology Co., Ltd. who run the main businesses of the Center.[2]

Information Center of Agriculture Department of China (ICADC). ICADC is an institute belonging to the Ministry of Agriculture. The function of the information analysis office is to analyze the agricultural economic situation and study hot spot issues. This office takes charge of estimating the

[2] http://www.cncic.gov.cn

expected target varying with month, season, half-annual and annual analysis, analyzing supply and demand, safety of the chief agricultural products, studying the development of the alarm system, developing the system of agriculture economic analysis, estimating model and developing the analysis of software, formulating the system of data, proposing the development of database and data, contacting firms where data are derived, overseeing data inquires and applications, establishing the national agriculture network, and displaying important data about through FAOSTAT (group of databases in multiple languages, owns at present more than 1,000,000 statistical data of every country arranged in chronological order) and so on.[3]

The National Marine Data and Information Service (NMDIS). Set up in 1958, NMDIS is under the supervision of State Oceanic Administration (SOA), and it is a national comprehensive sector for research on marine information technology and service for public benefit in the process of ocean management, ocean economic, ocean rights, and national military construction. It is composed of four operational systems, i.e., the National Oceanographic Data Center of China (CNODC), the Institute of Marine Scientific and Technological Information (IMSTI) including the National Marine Archives Center (NMAC), the China Operational Center of the International Ocean Institute (IOI-China) and the National Marine Space Information Research and Development Center (MSIRDC). The major tasks of the services are to organize and coordinate national work on marine data and provide scientific and technological information; take charge of the collection, processing, management, storage and service of various kinds of marine information; establish a variety of marine databases; and provide different marine information products and services. It has set up a special organization-Ocean Data Center. The functions of this center are as follows: collecting, dealing with and managing the basic data on oceans at home and abroad; creating databases; developing products and providing services; maintaining the World Data Center-Oceanography Research Center and the ocean information center of East Asia; managing the exchange of international ocean data and technique; formulating regulations, orders and technical standards about the management work of national ocean data; and organizing to put them into effect. The main data products are the products of ocean basic information data group, ocean environment statistical products, North-West Pacific hydrology weather net statistical products; circulation air disc of the China and Japan subtropical zone, the Bohai Sea、the Yellow Sea and the Donghai Sea atlas, or hydrology atlas， electronic version atlas of the hydrometeorological sea nearby China, electronic version of Chinese Ocean's Tropic Cyclone atlas, electronic version disc of atmospheric data, and hydrometeorological GIS products of oceans near China.[4]

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[3] http://www.agri.gov.cn/index.htm
[4] http://www.nmdis.gov.cn/al.htm

National Fundamental Geographic Information System (NFGIS). NFGIS's specialized information system, under the supervision of State Bureau of Surveying and Mapping, is one of the world's largest geographical information storage, data management, mapping production and data application systems. NSGIS establishes all kinds of basic geography information databases and data transfer network systems to collect, edict, deal with, and preserve basic geography information by various means. It is an important part of National Space Data Infrastructure (NSDI). NFGIS has been engaged in doing research projects since 1984 and accomplished the first project in 1994-setting up a national 1:1 million scale topographic database, a toponym database, a digital elevation model (DEM), a 1:4 million-scale topographic database, and an experimental gravity database. In 1998, it established a 1:1.25 thousand-scale topographic database, a toponym database, a digital elevation model (DEM). In 1999, it established a 1:10 thousand-scale DEM for the main seven rivers and a 1:50s-scale DEM for Three Gorges Reservoir of the Yangtze River. And so far it has established a national 1:50 thousand-scale topographic database, digital elevation model (DEM), and digital grid graph database.[5]

Center for Seismic Data and Information (CSDI). CSDI is the information center under the supervision of the China Seismological Bureau. It provides the Chinese seismic subject index, the abstract database of the periodicals about seismic, the bibliographic database of seismological documents, a union catalog of periodicals, a union catalog of Western periodicals, an abstract database of periodicals in English versions for seismological studies, a bibliographic database of global heavy earthquakes, a bibliographic database of Chinese seismological and other significant data resource services, all of which are issued in Chinese versions.

Information Center of the State Food and Drug Administration (ICSFDA). ICSFDA provides hundreds of databases through the China Medical Information Network. The databases include: Chinese Medical Science Periodical, Chinese Medicine Abstracts of Essays, Chinese Medicine Abstracts of Essays Database, Chinese Medicine Abstracts of Essays (on CD Rom), Chinese Patent Medicine documents database (1985-2003), Chinese Patent Medicine Instructions (on CD Rom, 1993-2003 annually), Chinese Medicine and Chemical Patent Products documents (on CD Rom, 1985-2003), and World New Drug Information in Studying, Developing, Cooperating and Transferring (2000).[6]

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[5] http://nfgis.nsdi.gov.cn/

[6] http://www.cpi.gov.cn/demo/netin/

Data System of Chinese Academy of Science. The data system of the Chinese Academy of Sciences (CAS) is one of the chief resources of Chinese scientific data. The Chinese Academy of Sciences not only possesses large numbers of institutions and information centers, but also has many special data centers, such as the Resource and Environment Science Information Center of the Chinese Academy of Sciences, and the Shanghai Life Science Information Center. Moreover, there are the Document and Information Center of the Chinese Academy of Sciences, the Wuhan Library and Information Center, and the Chengdu Library and Information Center, which all collect a large amount of scientific data. What's more, the Chinese Academy of Sciences has established the Chinese Science Digital Library (CSDL) and the National Scientific and Technological Library (NSTL), both of which support CAS' creative activities and provide original and specialized scientific data.

Take the Animal Department of China's Biography Information Center for example. It provides information and data service including China's vertebra animals' code, China's animal species catalogue database, China's protected and almost extinct animals' code, world animal name database, Chinese Animal Annals, an exemplary database, the document bibliography database of China's biological varieties (animal part), the expert database of China's biological varieties (part concerned with animals), China's medical animal database, China's animal model and sample database, the bibliography database of China's biological varieties, database index of China's biological varieties, and China's animal annals information and so on.[7]

Another example, the Resource and Environment Science Information Center of the Chinese Academy of Sciences (Lanzhou Library) is an important branch connection of the national science digital library, mainly engaging in document inquiry and information services for the resource and environment science fields, and in researching strategic information and intelligence. It is the platform of the Northwest Branch of the Chinese Academy of Sciences and Document Information System, and network gateway of the Lanzhou Science Innovation Base. At the same time, it is also a science and technology library which provides valuable services with respect to local economic construction and social development.

University Data Systems in China. More and more universities in China, especially research-oriented universities which have been listed in "211 Project" (one hundred best universities in the 21st century) of the Ministry of Education, have established labs with the national standard, research centers and project centers. Scientists of these research institutions undertake most of the

[7] http://monkey.ioz.ac.cn/division/inform.html

research projects funded by the government, including the project plan of high technology development (863 Project), national key scientific projects, national natural science foundation, national key basic research and development plan (973 Project), subjective project of basic research on key projects. Two-thirds of the National Natural Science Foundation of China' (NSFC) projects are undertaken by the universities in China.

The activities of these projects have produced lots of scientific data. The first Chinese visual human body data was accomplished by the scientific group led by Shaoxiang Zhang, a professor in the 3rd Military Medical University.[8] Another example: the Centre of BioInformatics at Peking University (CBI), which was founded in 1997, is China's national node of the European Molecular Biology Network (EMBnet) and the Asia Pacific Bioinformatics Network (APBioNet). In recent years, it has cooperated with several countries' bioinformatics centers, including European Bioinformatics Institute (EBI), International Protein Database and Analysis Center, International Genetic Engineering and Biotechnology Study Bureau, German Bio Project Research Bureau, British Gene Resource Center, British Human Genome Resources Center, Holland Bio Information Center, Australia Gene Information Center, and the Singapore Bioinformatics Center. It possesses the greatest variety of databases and the largest Bio-information database connection in China and it also provides the customers at home and abroad with lots of Bio-information service. CBI provides bioinformatics resources for domestic users, which includes both databases and software tools. More than 140 databases such as the DNA and protein sequence and structure, genome and sequence-related, mapping, mutation and literature reference databases have been installed in the database query system SRS (http://srs.pku.edu.cn/). Mirrors of dozens of sites such as ExPASy, GoldenPath, ENSEMBL, GDB, RGD (Rat Genome Database), S-Star (Bioinformatics online education), have been set up to make access easy for domestic users. Other bioinformatics information, such as description of software tools, user manuals, documents and workshop presentations were also put online either in English or in Chinese. A local BLAST server and the sequence analysis GUI JEMBOSS are open to the public through the Internet. A molecular design platform is accessible for local users. All the public databases and programs can be downloaded via the CBI FTP server. [9]

There are abundant documents and databases resources in China's universities. In order to develop China's academic educational document information work, the Education Ministry particularly built China Academic Library and Information System (CALIS). Under the leadership of the

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[8] Reported by Liu Kang and Huang He. Chinese "Visible Human" Born, *China Youth Daily*, October 25,2002

[9] http://www.cbi.pku.edu.cn/help/introduction.html (Jan.10, 2004)

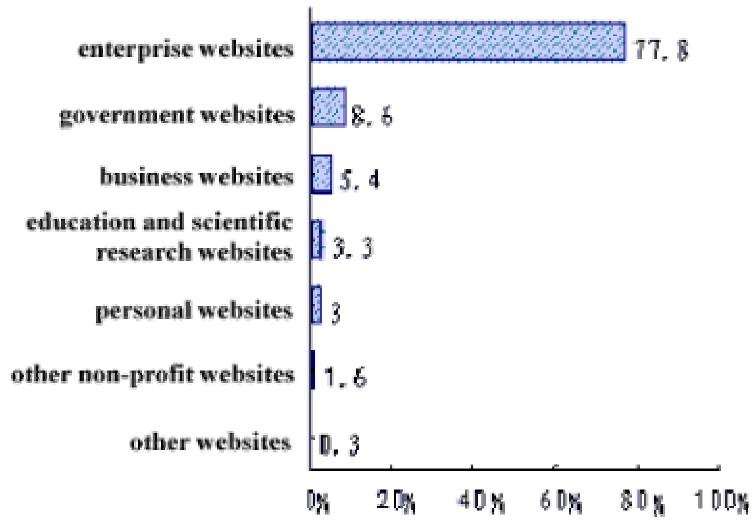
Ministry, CALIS aims at constructing the education information documents unite-guaranteed system with the core of China Academic Digital Library. During the ninth five-year-plan, China built four national information center covering art and science center, engineering center, agronomy center and medicine center, and has also set up seven regional centers, covering the north-eastern areas of China, south-eastern areas of China, central China, southern areas of China and one north-eastern national defending information center. In addition, CALIS has developed 152 academic fellowships, built a series of internal and external document databases, including self-set databases and recommended foreign databases, for example, the united directory databases and the present-issue directory bases in the Chinese version, etc. China initially plans to have accomplished China Digital Library of Higher Education by 2005.

Relatively Few Scientific Databases are On-line and with Unbalancing Regional Distribution. *Despite these accomplishments, taking an overall look at the whole national on-line network, there are relatively few Chinese scientific databases on-line compared with the total national on-line databases.*[10]

As for distribution according to the percentages of different kinds of websites, this paper uses CNNIC's criteria to divide the websites into the following categories according to the characters of the main body of the website，as shown in the following chart. In 2001, enterprise websites accounted for the largest proportion─about 77.8 percent of all websites; next were the websites of government organizations, accounted for 8.6 percent; while business websites accounted for 5.4 percent, and educational and scientific research organizations websites, 3.3 percent.[11]

[10] On-line data bases refer to those toll or free websites using Web as its interface and offering public searching service, Available at http://www.CNNIC.org.cn

[11] CNNIC.Survey Reports on Information Quantities of the Internet in China, Survey Report in 2001 (Main Part) 2. http://www.cnnic.net.cn/html/Dir/2003/12/15/2033.htm



Base=all the websites visited

[Note: business websites refer to those fictitious network-like websites e.g. such ".com" companies as sina and sohu. In contrast, enterprise websites are those of enterprises whose operation are mainly off- line. (cited from the sorting standards in by the American research institution Forrester Research).[12]]

A survey from CNNIC reported in July 2003 indicated that the total number of databases on line was 82,290. Among them the percentage of database owned by education and scientific websites was only 4.85 percent.

As for regional distribution of the on-line databases and records, these on-line databases are mainly scattered in North China, East China and South China. On-line databases in these three regions take up 72.4 percent of the total number. Those of Northwest China and Southwest China take up 8.8 percent, a relatively lower percentage.[13]

As to the regional distribution of the on-line database records, the proportion of South China is the biggest, 36.3 percent; the next is that of East China, 30.9 percent; the third is that of North China, 28.5 percent; whereas the total percentage of Northwest China and Southwest China is about 10 percent.[14]

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[12] CNNIC.*Survey Reports on Information Quantities of the Internet in China* ,Survey Report in 2001 (Main Part) 2 . http://www.cnnic.net.cn/html/Dir/2003/12/15/2033.htm

[13]Based on data provided by CNNIC.*Survey Reports on Information Quantities of the Internet in China* ,Survey Report in 2001 (Main Part). http://www.cnnic.org.cn

[14]Based on data provided by CNNIC.*Survey Reports on Information Quantities of the Internet in China* ,Survey Report in 2001 (Main Part). http://www.cnnic.org.cn

Chinese Scientists Appeal for Help in Sharing Scientific Data. Access to scientific data improves the efficiency of scientific research. In this sense, scientists can avoid investing resources to developing data that already exists elsewhere. So scientists in China are eager to share data so as to improve efficient use of current scientific data, and reinforce their capacity for developing new science and technology results. In the earlier period, Chinese scientists were acutely aware of the loss caused by having been unable to access scientific databases. So they appealed for access to nation-wide scientific databases. Dr. Liu Chuang, who is in charge of the research center on the global changing information from the Geographic Science and Resource Institute of China's Academy of Sciences，once remarked："Due to the lack of sharing of databases, we're always repeating the same work for colleting and analyzing the data in our research. This not only wastes money and manpower, but also restricts the improvement of research. For example, a set of basic climatic data or basic geographic data for Qing Zang Plateau costs more than RMB 200,000 Yuan and this makes a heavy burden on a medium scale research program; we can hardly bear it."

On climate research, the biggest problem which Chinese scientists face is that they can not conveniently get the scientific data. Therefore, in order to finish their research tasks, a lot of scientists try their best to make a detour abroad to ask for the climatic data of China, and as a result, this inevitably lowers the effectiveness of their research.

Lu Shihua, the Vice-Director of the Environmental and Engineering Research Institute of Cold and Dry Areas of Chinese Academy of Sciences says: "climatic research depends on the climatic data greatly, which influences the research task a great deal. We can do little without the climatic data. It's common to share data in foreign countries, and in the past we could get the Chinese climatic data more conveniently from abroad than at home. And now, we are happy to see that the climatic data are shared freely in our country, and of course, we will try our best to support the program."

The Chinese Government Puts Great Emphasis on Access to Data and Encourages Data Openness and Sharing. In recent years, the Chinese government paid more attention to the management and sharing of scientific data. In order to drive the sharing of scientific data ahead, the Ministry of Science and Technology started the construction of a batch of urgent basic scientific databases in 1999. In 2000, the Expert Group organized by Ministry together with the National Natural Science Foundation of China, suggested constructing fully-sharing scientific databases service systems within 10 years. In 2001, China's Meteorological Administration, with the help of the Ministry of Science and Technology, started to make experiments on meteorological databases and developed the services on database sharing. In 2002, under the support of the Ministry, the State Bureau of Survey and Mapping, China Seismological Bureau, the Ministry of Water

Resources, the State Forestry Administration, and the Agricultural Ministry started pilot projects on data sharing.

The National Survey and Mapping Bureau has, free of charge, offered basic geography data services to more than 30 ministries and commissions, provincial governments and to the experts who undertake important national science research projects. In order to do better in the work of management and sharing of scientific data, most of the ministries and commissions have set up specific information centers among which, there are, for example, the agriculture information center, the environmental information center, and the electronic information center. These centers do the work of building the databases or processing products and supplying the users with its products and information services as well as relevant technology support.

At present, the National Scientific Data Sharing Project of the Ministry of Science and Technology has started full scale operations. This project consists mainly of three parts, i.e. the construction of a data sharing and standard system of policy and relevant law acts; the construction of the national scientific data center groups; and the construction of the sharing of scientific data service web-sites. It is estimated that by 2005 to 2010, China will have generally accomplished the national scientific database center group and the database sharing networking systems, which will cover the whole nation and have a more reasonable structure and distribution. And this project also forms the positive exchange and renovation system of scientific data to meet the needs of the government ministries, the research and educational organizations, and society. In this way, we can make the standard of the sharing of scientific databases in China reach that of the developed countries in 1990s.[15]

Nowadays, "a leading group of sharing data science and technology platform" has been set up across departments. Mr. Xu Guanhua, the Minister of the Ministry of Science and Technology, has tasked the leader of the group to start experimental work on "the digital science and technology platform" construction, which is the biggest part of the project. The main work of the group is to classify the massive and scattered science and technologic data resources and convert them into digital forms, then form several scientific database centers, digital sources centers, digital museums or digital science and technology libraries.

Since January 10, 2003, China basic science research net (www.br.gov.cn) - a specialized government website to offer relevant information of China's basic research fields - has formally

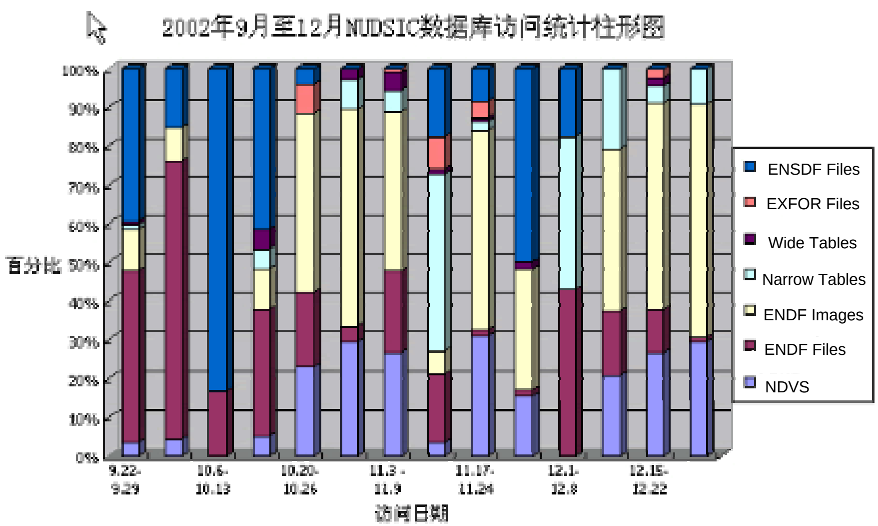
[15] Scientific Data Sharing Project is to Start, Xinhua net, visited April 1,2003

been in operation. The website is to integrate all sorts of scientific data sources in a unified public platform.

The regional governments in China also pay close attention to access to scientific data. For example, the Science and Technology Commission of Shanghai Municipality, relies on the southern research branch of the National Gene Research Center, Shanghai Life Science Institute of Chinese Academy of Sciences, Fudan University, Shanghai Communication University, Shanghai University and many relevant research institutions. Relations among these institutions has been reorganized somewhat through adjustment and coordination of manpower in the domain of the local biology and information sciences. In 2002 on the basis of these adjustments, which required an investment of total of 11 million Yuan, the Shanghai Center for Bioinformation Technology (SCBIT) was established—the first institution in China created for the purpose of data sharing in the domain of the national bioinformation. SCBIT, a non-profit organization, has become an independent legal entity under the administration of the Science & Technology Commission of the Shanghai Municipality. SCBIT's mission is to promote the advancement of life sciences, biotechnology and the biopharmaceutical industry in the Shanghai area as well as nationwide, including building bioinformatics platforms with the latest technologies and broad applications for data collection, analyses, and knowledge discovery, and developing national standards for bioinformatics databases.

Mechanisms for Improved Access to Scientific Data Have Had a Positive Impact. China has achieved good results in the process of encouraging scientific data to be shared publicly. For example, in May 2001, the Ministry of Education funded the Nuclear Science and Technology Virtual Research Center affiliated jointly with Peking University, Tsinghua University, Sichuan University and Lanzhou University. The center conducts the program of Nuclear Scientific Database Construction and its Network Sharing. The center's database started to operate in September 2001, offering the public continuous on-line data browsing and downloading services. And the operation of the system indicates that it is stable, dependable and safe. The initial statistical daily record of service machines from September through December 2002 showed the databases offering 400 or so data files for downloading services per month. The IP address for visiting the database covered 50 countries, regions and organizations, and the number of persons who visited the database was over 600,000, and the registered users were also over 200,000. These statistics this database attracted its own users and visitors and created great influence on nuclear research at home and abroad. The programmers adopted advanced computerized techniques, the techniques of database and Internet, and have researched and operated the first web nuclear scientific data intelligence service system, therefore, it's the first net in China to provide free online access service through Internet to eight leading international nuclear scientific databases (ENDF/B-6, JENDL-3.3,

CENDL-2.1, JEF-22, BROND-2, EXFOR, ENSDF and IAEA). This is great progress in the publishing of nuclear scientific data and the construction of nuclear science informationization in China. The chart below reflected access to this database from September to December 2002 and showed that it has been evidently noticed by scientists from all over the world.[16]



Before the network came into use, geological materials had been shared widely in China. The National Geological Library and the National Geological Reference Room are two of the main institutions to provide geological materials sharing in China. The sharing regulations of non-digital-storing geological materials are laid down in accordance with the national provisions of a series of systems, such as collecting, storing, converting and securing geological materials. In June of 2000, the Ministry of Land and Resources of China issued No.9 Announcement *About the Range of Public-Welfare-Geological-Materials*, which extended the range of utilizing public-welfare-geological-materials openly in society. According to the provision of No.9 Announcement WDCD, the geological scientific database belonging to the information center of Chinese Geological Scientific Institute, has been providing service since the end of 2001. The sharing of this database is classified into two levels—social sharing level and internal sharing level.

Meteorological science data is a vital aspect of our national fundamental information resource base. As an important field of fundamental public welfare scientific data, meteorological science data is a significant data resource in many science research activities such as atmosphere, ocean and agricultural ecology. In the process of research about global hot spots of science, such as global variation and desertification, access to integrated and available meteorological scientific data is

[16] Nuclear Data Service In China(NUDSIC), http://dbs.nst.pku.edu.cn/

regarded as the most important task. Therefore, meteorological science data plays a leading role in the process of national scientific and technological progress and innovation, and the supply cannot keep pace with the increasing demand. With the support of the Ministry of Science and Technology, China's Meteorological Administration (CMA) is the first organization to start an experimental program of sharing meteorological data and published *The Regulation on Sharing Meteorological Reference*, which initially settled the problem of sharing scientific data in the meteorological sphere, a problem which had perplexed scientific and technological circles for many years.

China's scientific data are making a contribution to global scientific development. For example, from January 14 to March 2, 2002, the rice genome mapped by Chinese scientists had been downloaded by laboratories from all over the world at least 556 times. These laboratories come from 21 countries, including both the scientists who are engaged in rice basic research and the experts who are occupied with rice breeding. The experts in genomics funded by the US National Science Foundation (NSF), expressed heartfelt gratitude to the Chinese scientists for promulgating rice genome data "unselfishly" and thanks to these data they accomplished the relevant experiments one year earlier than expected. Experts on plant genomics from a national laboratory of South Korea, once said: "From your array, we can find complicated array which might have taken us several years to measure, and the finding makes our research fulfilled almost three years ahead of schedule!"[17] It is reported that these data are available from the network address of Beijing Genomics Institute and International GenBank.

II. Problems in Mechanisms for Access to Scientific Data

At present, many problems still exist in mechanisms for access to scientific data in China, including the following:

Quality and Accessibility of Databases for the Public. First, data quality needs to be improved. The effectiveness of data exploitation is still unsatisfactory. A huge amount of raw data, especially those surveyed via satellite, radar, etc, are not well organized and a large amount of material in paper form have not yet been digitized. These observation materials need systematic scientific processing and analysis. In fact, some images and pictures are poor in quality. Only five types of data resources have been created in the present meteorological scientific data sharing activity: national-level basic meteorological materials, provincial meteorological materials, satellite remote sensing materials, professional meteorological materials and the first stage of digital control product

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[17] Reported by Li Bin**.** China Rice Gene Group Arrays Data Has Been Downloaded 556 Times (April 6, 2003), http://www.xinhua.net.

in historical materials, namely the national-level basic meteorological materials.

The resource and environmental data center, organized by the Institute of Geographical Sciences and Natural Resources Research under the Chinese Academy of Sciences, is the first data center to structure, integrate, upgrade and share the space data in the fields of environment resources. The Chinese Resources and Environment Database states, "the pictures and data of the database are only used to prove the content and function of the database, most of the pictures are not the original scales and hues, so can't be utilized for other purpose". However, it also states that if users purchase the data, the high-quality data may be available". The users can obtain the 1:100 thousand-scale and the 1:250 thousand-scale topographic map of land utilized, a kilometer of AVHR, the land category, TM remote sensing video, some three-dimensional pictures of city, c-star pictures from N0.1 Wind & Cloud Satellite, the background of ecological environment, etc. Whereas a large number of materials concerning some regions or cities are not available to be retrieved, the quality of the data is also unsatisfactory.

Second, the quality of the databases are not satisfactory. The problem lies in databases which cover only a short period of time and in which the data are updated slowly, which decreased their validity The renewal cycle of these data bases takes too long. The data were not integrated in scale and substance when data resources were collected, put in storage, and retrieved. There is a lack of inter-departmental co-operation in database construction. At present, except that the minority of database which can be updated on the Internet on a weekly basis, the majority of databases can be updated once from three to six months on average, and for some worse databases, even once annually. Some document databases have already stopped updating.[18] According to the 2001 *Survey Report on the Quantity of China's Internet Information Resources* of CNNIC, the rate of on-line database updating is rather low. About 35 percent of the web-sites enjoy on-line databases updated weekly. The all-records weekly updating rate is from 1 percent to 5 percent. The weekly updating rate of another 20 percent of the web-sites is below 1 percent.

Third, many online databases cannot be accessed conveniently. I logged on to the site

[18] Li Xuehui, Cao Zhouhua, A Survey of 2000 Chinese Document Database Construction and Application, *Chinese Information Yearbook*, 2001, p. 301

http://www.reidc.ac.cn /introduce/introduce.asp from Wuhan with ISDL on March 12, 2003). This is a data sharing site. The results are given in the following table, which shows that only two out of six databases actually provide information. The invalidity database rate is 67.3 percent of the total.

Environment and Space DB on the land resource	Valid access
Natural resources DB	Invalid access
DB retrieval engine	Invalid access
Agriculture resource DB	Valid access
Data download	Invalid access
Environment resource DB	Invalid access

On September 6, 2003, at 18:20, I relogged on to the site, and found that only two out of six databases could not be access (data download and environment resource databases).

On March 12, 2003, I also logged onto the Nano Science and Technology Network of the CAS at http://www.casnano.net.cn/gb/index_gb.html, which is built by CAS aiming at researching nano technology. The center maintains 14 databases but only three can be accessed, which is 21.42 percent of the total. The other 11 databases are invalid, which is 67.3 percent of the total.

China NANO patent open Database	Valid access
China NANO patent authority DATABASE	Valid access
Foreign NANO patent DATABASE	Valid access
NANO productions DATABASE	Invalid access
NANO documents DATABASE	Invalid access
NANO products firm DATABASE	Invalid access
NANO task DATABASE	Invalid access
NANO research institutes DATABASE	Invalid access
NANO experts DATABASE	Invalid access
NANO instruments DATABASE	Invalid access
NANO testing technology DATABASE	Invalid access
NANO products DATABASE	Invalid access
NANO apparatus DATABASE	Invalid access
China and foreign NANO standards DATABASE	Invalid access

(Access time: 23:15 on March 12, 2003)

On September 6, 2003, Saturday at 18:40, I relogged onto this site, and found that the accessed databases increased (NANO task DATABASE and NANO experts DATABASE) to five, which is 35.7 percent of the total.

Information Blockades and Barriers Among Government Departments and Systems. First of all, scientific data blockades exist among the government departments and among many systems administrated by different departments, which lead to the serious wasting of information resources. In the past 20 years, our country has invested a huge sum of money to launch extensive investigations and observation about geology, meteorological phenomena, ocean, hydrology, the environment, earthquakes, and so on. The country has accumulated substantial scientific data and has built more than 5,000 scientific databases. About 30 to 50 percent of the funds devoted to national science and technology projects were used for obtaining these scientific data. During the Ninth Five-Year Plan Period, direct national investments to surveys and research in the field of the environment and natural resources reached at least RMB 20 billion Yuan.[19] Yet due to faulty management mechanisms, the information among the departments and among different systems are blockaded and the barriers are very serious. Large quantities of scientific data are kept in different units, departments and by different experts, which cause the data to be hardly available. Many data are dispersed or lost and users seldom enjoy shared application. In order to access data, some geological prospecting units repeated drilling in very nearby places for the same exploration and for the same purpose.

Second, China lacks in technical specification and has incompatible technologies for database building, which lead to isolated informational areas. Many databases built by different institutions, due to the lack of the unified standard, for instance, code system, format standards, etc, have become isolated information areas incompatible and unable to communicate with one another. One of the results of the isolated information area phenomena is that large skilled labor force and substantial material resources are wasted in the low-level and repetitive construction of databases. What is worse, it caused the technological difficulty in information processing, information exchanging, database maintenance and updating. Each unit sets up its own data property right protection, regulation, agreement separately and respectively. Due to the restriction of the standard of the network, the data among the departments and areas can't be shared. A lot of databases still remain at the level of internal exchange and will be unable to satisfy the demand of information sharing unless they are reconstructed.

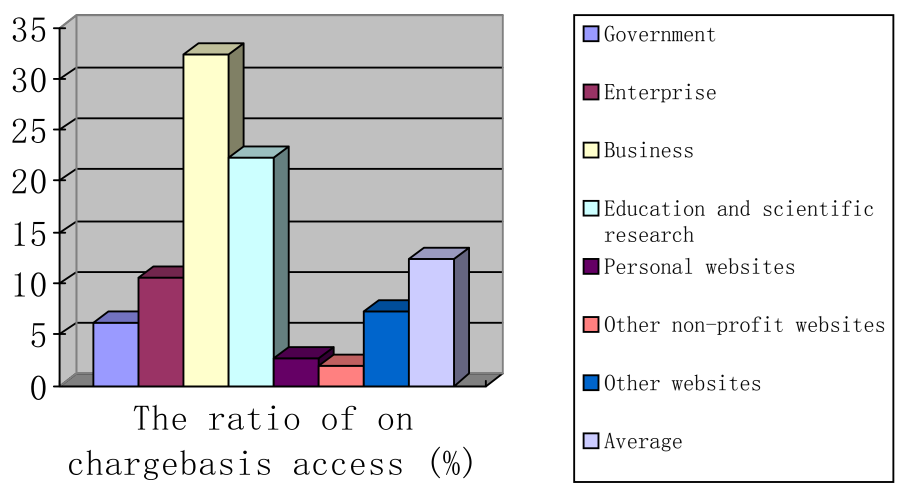
Many Scientific Data Owned by the Government Remain Unused. First of all, a lot of valuable data resources owned by the government are not exploited in a timely manner. These resources include the data from government subsidized research projects, such as research reports, data that functional department get when they fulfill their functions, and data from government research institutions. Because there are not enough funds and human resources to exploit these data, the scientific findings can’t be used productively.

[19] Ren Jianming. *People's Daily*, Dec. 10, 2002

The Chinese government has 80 percent of existing valuable information in social resources, but only 10 percent of the information can be utilized effectively. In this way, enterprises and individuals who need information cannot find it through the information channels. Additionally, a large amount of information is "locked" in the office of the government departments. The system of scientific and technological data utilization formed in the era of the planned economic system is still hindering the sharing of the information resources. There are several reasons for this state of affairs, for example, the lack of necessary information standards, the lack of adequate information working staff, the overlap of some departmental functions, unreasonable organizational structure and administrative procedures are all obstacles in accessing data, sharing information, and exchanging information. In the current environment, many departments have not included information access as the responsibilities of the department's activities.

Second, information rent-seeking still exists under some circumstance. Some government information departments seek to rent information for their own economic benefit.

According to the *Survey Reports on Information Quantities of the Internet in China* issued by CNNIC in June 2003, the proportion of online government database is 12.3 percent of the total online databases in China. Among the total databases, education, science and technology websites have the second highest ratio (22.3 percent), only lower than that of business websites. The chart below shows the details.



Third, China lacks high-efficient platforms for national data sharing. Although expenditures for directly accessing data has reached 50 percent of the total funds in some projects of the national science and technology plan, yet the lack of s sound data sharing platform has led to the result that after the accomplishment of the research project supported by the government, the scientific materials are, due to dispersed distributing, still incapable of being shared. It is difficult, at present, for databases built by some units to support the national economic construction effectively and meet the needs of national economic sustainable and continuous advance.

The Quantity of Scientific Data in Chinese on the Internet is Much Lower than the Quantity in English, and the Gap is Increasing. In order to discover the quantity of online data in Chinese, especially the quantitative difference between online scientific data in Chinese and in English, I did an experiment: inputting a key word in Chinese and did word for word translation to match a key word in English so as to search via Google Search in the site Google.com. The results are the following :

Key words in Chinese	Result of search	Key words in English	Result of search	Proportion between Chinese and English
癌 数据	228000	Cancer Data	1980000	1:8.684
艾 滋	35300	AIDS	11000000	1:311.6
艾滋 数据	1580	AIDS DATA	1930000	1:1221.5
基因数据库	31510	Genome Database	423000	1:13.42
人类基因数据	9070	Human Genome Data	487000	1:53.69
人类基因组计划	9070	Human Genome project	468000	1:51.6
基 因	99000	Gene	943000	1:9.53
基因 数据	64700	Gene Data	1590000	1:24.57
基因工程	83100	Genetic Engineering	871000	1:10.48
基因工程 数据	11100	Genetic Engineering Data	470000	1:42.34
可 视 人	2100	Visible Human	1800000	1:857.14
可视人 数据	862	Visible Human Data	1010000	1:1171.69
全球气候变暖	7130	Global Warming	1050000	1:147.27
全球变暖 数据	2940	Global Warming Data	439000	1:149.32
地震 数据	40500	Earthquake data	497000	1:12.27
动物灭绝 数据	136	Animal Disappear Data	95400	1:701.47
环境保护 数据	57800	Environment Data	2000000	1:34.60
二氧化碳 数据	14100	Dioxide(CO2) Data	127000	1:9
信息鸿沟	343	Information Divide	1700000	1:4956
Average				1：534

The experiment shows that online data in Chinese is less than 1 percent of the amount of online data in English. Online data in Chinese are quite scarce, the gap between the scientific and technological data in Chinese and the scientific and technological data in English is continuously increasing.[20]

[20]. The author will continue to conduct these experiments by using a larger size sample and write a thesis on *The Procedures of the Investigation on the Internet Scientific Data & the Results*.

The Uncertainty of Scientific Data and the Failure of the Data Market Both the state and the enterprise invest in science and technology projects to access scientific data, which causes property rights to the data to be uncertain and unclear. The market's lack of norms or specific definitions to regulate intellectual property for data results in ambiguities as to whether the data can be shared and under what conditions. In addition, it is serious and unreasonable in domestic policy to pay more attention to scientific papers published in journals, but pay less attention to the data collected and produced for scientific exploitation, which can't attract the researchers to put more time and energy into developing the data.[21] The intellectual property right to scientific and technological work is definite, but the intellectual property right to the data is ambiguous. To some extent there are contradictions between the principle of full and complete open data and protection of intellectual property rights. To emphasize excessively, intellectual property rights may lead to the difficulty in implementing the principle of complete opening.

CODATA published an article in 1997 and demonstrated that intellectual property rights threatened open scientific data. If scientific databases serve society, the primary problem to tackle is pricing policy and strategy, which concerns many problems, such as intellectual property rights. At present, some databases have adopted a high pricing policy, and the result is that there are fewer users, the market share is smaller, which limits the development of the business of the database service. Other databases adopt low pricing policy, which increases the number of users, but the unit which built the databases suffers losses. Such a unit has no alternative but to depend on the government's financial support to go on running. So it is unable to arouse the enthusiasm of unit which intend to build databases.[22] How to carry on profitable operation of commercial scientific data bases based is still a difficult problem to overcome. China still has a long way to go to discover suitable patterns to adapt to its actual conditions. The share of on-line Chinese data in the international data market occupies about 1 percent. The mechanism of market-regulating of data supply and demand is working inefficiently and ineffectively.

China's system of intellectual property system is twenty years young. However, we must see with sober minds that there is still a great deal to do to improve our system. For example, Section 6 of Article 47 of Copyright Law of the People's Republic of China (2001) prohibits the "intentionally circumventing or sabotaging the technological measures adopted by a rightful owner or an owner of rights related to the copyright to protect the copyright or the rights related to the copyright in the

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[21] Liu Chuang, Data Sharing Relies on the Construction of Mechanism, *Science Times Newspaper*, Jan.22, 2003

[22] Li Wangping. Zhang Jianzhong, On the Pricing of Scientific Database in Internet Information Service， The Computer Net Information Center of the Chinese Academy of Sciences, Beijing, 100080

work or the product sound recording or video recording, without the permission of the owner, or the owner of the copyright-related rights, unless otherwise provided in law or in administrative regulations". We should pay great attention to the rule because it is related closely to data access. "Avoiding on purpose" in the legal provisions is the behavior of prohibition, which permits the database producer to restrain data use in the public domain, and withholds government information from access on the part of common readers. It is applicable to the situation of the network. The regulation of "ultra world standard" does exist in the law of intellectual property rights of our country.[23]

Because funds for scientific research in our country are mainly provided by the government, the property right of the corresponding scientific data is unclear, which lead to the high costs to get scientific data. For example, although ocean monitoring ships cost more than one hundred million RMB, petroleum, geology, and aquatic units each has one. As for the large-scale remote sensing satellite data receiving stations, there are three in Beijing area alone, whereas there only two comparable facilities in the whole Europe. In some units, scientific research equipment invested by the government is treated as the private property of the unit or department.[24] So the corresponding scientific data naturally comes to be regarded as the property of each unit. The high cost to access scientific data and ambiguous intellectual property rights are two main obstacles to the establishment of valid adjustments of the regulations to market mechanisms.

III. Proposals to Improve Access to Scientific Data in China

Establish Compulsory Legal Mechanism to Promote the Complete Openness of Scientific Data. Opening data sources is the basic condition for public access to these data. In order to break data barriers, we must, above all, establish policies and regulations to ensure data availability. At present, many countries pay a great deal of attention to the legal construction of the data opening and data sharing. For example, in 1967, the US Congress enacted the Freedom of Information Law, and has revised it many times. The primary problem that freedom of information laws needs to solve is to guarantee the public the right to access the government's information.

The US government has also formulated rules for managing data produced through its financial support of non-profit institutions and for-profit enterprises to conduct scientific research. These laws

24. Qiao Sheng, The Current State and Pondering of the Protection on Intellectual Property Right in China. *Law and Trade Research*. (3), 2002

[24]The Conditions of Science and Technology Department and the Views from Director Zhang Yuying. cf. The Surprising Waste of China's Large Equipment from CCTV.com.cn., http://www.cas.ac.cn/html/Dir/ 2002/12/12/3809.htm

and regulations above guarantee that the data and information obtained from research funded by the federal government will be fully and completely open.

Governments are the most important of all information producers and disseminators, so the primary task is to assure that the information controlled by the government is open to the public. At present, it is imperative to strengthen legislation with respect to open information because a lot of information controlled by the government is in the state of remaining partly or totally unused. Therefore, in the legislation on open information, it is very important to confirm the principle of open information, to delimit the range of the government obligation to open information, to differentiate the right and obligation, the responsibility and obligation regarding information issues. On the premise of guaranteeing the security of information, only by breaking the information monopoly of governmental departments, by fully opening scientific information controlled by or provided to the government to the public, will it be possible to set up effective mechanisms of access to government information.

Establish Technology Support Mechanisms to Promote Data Sharing. Data sharing depends on the security system of the government. The system includes data developing and sharing policy, technical standards, technological platform, and data production and transmission channels. The construction of national-level data center and data sharing networks ensures that scientific data will be produced continually, and that information sharing channel will work smoothly. The security mechanism encourages the whole society (including private corporations) to utilize the data with cost price (not to exceed expenses of data duplicating and transmitting), strengthens the supervision of data quality, assessment, coordination and management. The data should be produced by information centers of departments of the national government, the CAS, universities, and other non-commercial institutions via government investment in scientific research. The system also improves training and cultivation of scientific talent for data sharing and data service.

The essential means to realize the value of scientific data is data flow and extensive data application in science research and social development. Building security mechanisms consistent with full and open data sharing will have a positive impact on data flow and data utilization.

The government should be responsible for the construction of public platforms for developing and sharing data. Since 1994, the geo-science department of the Chinese Academy of Sciences has appealed many times to break data barriers in the geo-sciences in order to realize the data sharing. However, it is far from effective for the scientists to appeal to solve the problem of scientific data sharing. The state must implement the overall planning from a national aspect, coordinate with various departments, and establish security mechanisms for data sharing.

The state should strengthen the standard construction of data so as to improve the quality of the data, adopt the international standard, establish scientific data standards and norms. Through regulation and policy, the state can strengthen the control to and improve the quality and precision of scientific data.

Establish Market-oriented Adjustment Mechanisms to Promote a Beneficial Balance Among Data Producers, Database Makers and the Public. Scientific data are a public good. Therefore the essence of managing scientific data sharing is to realize social resources sharing and realize the greatest value of this particular social public resource. There are to some degree difficulties in intellectual property protection. So it is of great significance to take relevant measures, define the investment ownership of scientific data, and differentiate the rights and the obligations in the course of the scientific data production and propagation so as to share effectively scientific data produced by government investment.

The state should implement complete and free sharing of scientific data produced through public investments, focusing on the commonweal and basic scientific data produced through by state and accumulated in the long run.

As for the scientific data and data produced by means of the investment of enterprises or the private sector, commercialized operation could be implemented to realize data sharing with compensation. It is necessary to probe the management mode for commercial scientific data sharing with compensation to foster the market for scientific data products and to cultivate the service industry of data products.

In summary, the data resources that the government develops and invests in for the conduct of scientific research currently represents the bulk of those resources. But what the enterprises and the private sector develop is an important supplement. So a major problem is how to balance the benefits among the public, the state, enterprises and the individual. We should consider this problem from several perspectives, such as science, economics, and law.

The experience of the United States in this respect is worth studying. The US government, according to the difference of sources of investment in scientific data management, distinguishes between two different types of management mechanism of the data sharing. The data that the government possesses, produces and invests for production is to be fully and completely open. Under the protection of this mechanism, citizens can obtain the data with the expense of no more than the cost, in a most convenient way, without discrimination. The data produced through private corporation investment to produce are regulated by the market mechanism of fair competition. US government grants licenses permitting different companies to adopt the policy of encouraging fair competition, and decreasing the price of data through market adjustment so as to achieve the goal of allowing the data to be put into actual use. Meanwhile, the government regulates and controls through the tax revenue. These two kinds of mechanisms complement each other and promote access to scientific data to be shared and used extensively for the whole society.

The market will play an important role in the process of setting up this kind of mechanism. There are many modes to promote public access to scientific data successfully, which can be taken for reference, such as the Chemical Digest Society of the United States and DIALOG Data Company. Even the "full and open" availability service mode of the data sharing can carry a monetary cost, but requirement should be no more than the cost of reproduction and distribution.[25]

Establish Cooperative Mechanisms for International Access to Data Aimed at Eliminating the International Information Gap. Cooperation with respect to access to scientific data internationally can save a large amount of manpower and money and reduce repeated and redundant database construction. At present, more than 20 countries have developed scientific data sharing and management policies. International scientific data organization utilizes the Internet to structure in succession the world weather monitoring net, the global resource information database, the international calamity information resources network and the international ocean materials exchange system. These have provided scientific data interchange activity with a global yardstick. They also share service systems to some extent. As a large developing country, China must improve the scientific and technological competitive ability before it participates in global cooperation and competition at the omni-directional and higher level. In pursuing this goal, it is necessary for China to implement, as soon as possible, scientific data sharing, and to form a sound scientific and technological competitive environment. Effective scientific data sharing and a sound competitive environment can support the country's scientific and technological competitive ability and its sustainable development. The fact that the Chinese government pays great attention to information construction provides a good foundation for the realization of international cooperation.

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[25] Based on NAS/NRC reports, "full and open availability" is defined as being available without restriction, on a non-discriminatory basis, for no more than the cost of reproduction and distribution." see: J. Baker, Chair, Subcommittee on Environment and Natural Resources, DMWG "Full and Open" Definition (1997) October 6, 1997. http://globalchange.gov/policies/diwg/dmwg-fando.html

In conclusion, international cooperation is a promising trend, because data are available beyond national boundaries. All countries should take positive measures to set up effective data access mechanisms so as to strive for the realization of data resources sharing and co-operation as soon as possible. They should strengthen further cooperation in the field of the international scientific data sharing, narrow the international scientific data gap, recognize the value of scientific data in global scientific and technical innovation and in facilitating sustainable development for the purpose of promoting mutual progress for human beings in all the world.

Current Situation and Prospect of E-learning in China

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I. Introduction

With the progress and development of human society, the speed of knowledge renewal becomes faster and faster. In future, the society put forward higher requests for the laborers. In 1998, UNESCO (United Nations Educational, Scientific, and Cultural Organization) pointed out in one of his investigation reports: "Regardless of developed countries or developing countries, there has been the problem that education has lagged behind realistic demands in various degrees." Besides traditional school education, continuing education and life-long education have become a necessary part of future society. The demand for laborers' study will be characterized by popularization and individualized life-long learning. The basic target of future education will be to provide a broad, multi-dimensional, omni-directional service and ensure that anybody can gain the necessary education anytime and anywhere.

China is a developing country with a large population. From the view of education, though, the government has developed many types of education and great progress has already been made. However, only 14 percent of the population of the relevant age can gain advanced education in colleges and universities. This small proportion indicates a substantial gap between developed countries and our country. Moreover, because the development of various regions is uneven in China, most of the people who cannot gain nine-year compulsory education are located in the impoverished areas of the Midwest and the border areas where most ethnic minorities live. In terms of both educational quantity and quality, the Midwestern area is in a disadvantageous position. And the large gap between the social demands and the lack of educational resources is substantial. Education in our country will also face problems associated with international cooperation and competition now that China has joined the WTO (World Trade Organization).

Serious problems for the future will be how to solve the discrepancy between social demands and the lack of educational resources, how to correctly utilize and share limited education resources, and how to improve the quality of elite cultivation. In view of conditions in China and the current situation of education, we expect an efficient method to make the best use of limited educational resources, to increase the degree of educational popularization, to improve teaching quality, to decrease differences between the eastern and the western parts of the country, and to cultivate innovative talents. This will result in constructing a system for life-long study for the whole society. Modern pedagogy and information technology based on computer, network and multimedia, combine to make e-learning, which is different from traditional education pattern. It has the advantages of enormous information resources, powerful modes for interaction, and unlimited space-time. E-learning will not only become the most effective way of solving the problems mentioned above, but will also become an important impetus for reforming traditional education patterns. The implementation of e-learning is regarded as a strategic action to enable our country to expand its educational scale, improve educational quality, increase educational efficiency, and construct a system of life-long education... Developing e-learning will help to deepen the reform of our educational system and implement the strategy of achieving prosperity through science and education. It will help to share educational resources, reduce educational costs, popularize quality education, help to promote the formation and development of the rising information service and educational software industries, and help to improve the international competitiveness of the educational industry of our country.

Compared with western developed countries, e-learning in our country started at a late stage. The experience in developing e-learning abroad can become our best textbook. So in this paper, an overview of e-learning abroad will first be introduced, and then the current situation in the development of e-learning and some problems faced at present in our country was given. After these introductions, E-learning Key Technologies and Demonstration Projects which have been initiated by our government to accelerate the development of e-learning in China will be discussed and as well as the influence of these projects on the development of Chinese e-learning.

II. Overview of E-learning Abroad

Developing e-learning can expand an educational scale, improve educational quality, increase educational efficiency, and construct a system of life-long education. Many countries have paid unprecedented attention to the development of e-learning and in order to advance their societies. The United States, Britain and Japan are particularly outstanding in this respect.

United States. The scale of e-learning in United States. is the largest in the world at present. Nearly all universities, middle and primary schools in have been connected to the Internet and have implemented e-learning in various degrees. 1996 was a significant year for the development history of American e-learning. During that year, US President Clinton put forward an ambitious e-learning plan, and its goals were that every classroom and library in America would be connected to the Internet by 2000, that every child could read at eight years old, surf the net by 12 years old, and enter university by 18 years old. An additional goal was that every adult American could have access to life-long study. In order to respond to the rapid development of information technology during last half of the 1990s, the US Department of Education issued its first formal report on e-learning, *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*, which advanced national goals for e-learning[1]. This report has played a positive role in leading and promoting the development of e-learning in United States, helping students master information technology, and improving their ability to meet the challenge of society in the future. Starting in 1996, United States began to devote resources to address this national goal.

With the continual renovation of information technology and the development of e-learning, a report entitled *E-learning: Putting a World-Class Education at the Fingertips of All Children* was published by the International Society for Technology in Education. in 2000[2]. which carried on important amendment to the goals for national e-learning put forward in 1996. By deleting some objectives from the Department of Education report that had been realized and adding some new objectives, this report provided a development blueprint for American e-learning in the early years of the 21st century.

According to the National Center for Education Statistics, by the autumn of 2000, the average percentage of schools providing students with Internet-connected computers had reached 98 percent, and 77 percent of classrooms had been connected to the Internet. The ratio of students to computers in public schools had risen to 5 to 1. That is, the goal that all middle and primary schools in America should be connected to the Internet had basically been realized. In the field of higher education, 44 percent of universities offered varied distance education courses, while 21 percent planned to start offering distance education courses during the next three years. Academic credentials and degree-grant programs were the main forms of distance education in American universities. Among 1.6 million students enrolled in distance education, 1.4 million were studying academic credential or degree-granting courses, 1.08 million of them undergraduates and the remainder 0.0281 million graduate students. An estimated 49,000 different distance education

[1] United States Department of Education: *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*, 1996. http://www.edu.gov/Technology/
[2] International Society for Technology in Education, *E-Learning: Putting a World-Class Education at the Fingertips of All Children,* 2000. http://www.edu.gov/Technology/

courses were offered, covering almost all of fields and specialties in American universities. A nationwide education network which covered the main educational institutions had also come into being.

UK. In the popularization and development of e-learning, the British government constructed the necessary infrastructure at an early and has taken effective measures to strengthen it. As far back as in 1995, the British government put out an action plan entitled, *Education Superhighway—The Road Ahead*[3]. The government networked 400 educational institutions and appropriated for 23 experimental programs. In October of the same year, Prime Minister Blair announced a five-year-plan named The Year for British E-learning", guaranteeing $160 million dollars for interconnecting all of the middle and primary schools. According research published at the beginning of 1997, Britain was the only country at that time which allocated computers to all primary schools. The ratio of pupils to computers was 17 to 1. And, national courses offered by British middle and primary schools could be accessed via Internet.

While strengthening infrastructure construction, the British government set about undertaking educational reform and built e-learning demonstration projects. In 1998, E-Learning Year in Britain, the plan for surfing the Net for study was implemented. On April 16 of that year, the British government announced a policy through a report entitled *Our Information Age*. This report emphasized that the government should reform education, utilize the new technologies in education, provide people with the means to obtain necessary knowledge and technical ability in the information age, expand range of those benefiting from available information, and assume a major role in guaranteeing the availability of information to the common people. In the same year, the British government stipulated in legislative form that information technology courses would be changed from elective to required courses, and established nine criteria standards for assessing information technology courses in middle schools. Six percent of the education funds in the country were set aside for computer purchase so as to ensure that 20 percent of the middle and primary schools in Britain could be connected to the Internet. In February 2000, the Secretary for Education and Employment, David Blunkett, announced that Britain would implement a plan named E-University. Its purpose would be to combine the strength of different universities and set up a totally open network university accessible by the whole society and the whole world. The government planned to offer distance education to the world through Britain's existing JANET system. The British government would invest 50 million pounds to compete with America, to occupy 25 percent of overseas educational markets in English-speaking nations, and to attract over 75,000

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[3] http://www.hefce.ac.uk.

overseas students before 2005. Initially, the system has aimed at clients in Singapore, Malaysia, Indonesia, China, Argentina and India. The E-university is to be a university organization without campus. Students could choose courses that any university in the UK offers.

Japan. Japan has also rapidly information-based education too, there has been an emphasis on catching up with or surpassing America and Europe. Early in August 1995, *Monbusho*, the Ministry of Education, Science, Sports and Culture of Japan, published, *Principles about Realizing Informationize in the Fields of Education, Science, Culture and Sports*. The principles emphasized that Japan should undertake a rapid construction in information infrastructure, improve the environment for network research, and develop new multimedia-based teaching methods. In August 1997, am educational reform plan was amended to state that Japan should set up a network by Comsat and improve multimedia usage. The new educational reform plan approved of course credits based on multimedia teaching, and set up graduate school of correspondence courses which *Monbusho* had refused to sanction in the past. Using multimedia in higher education and distance education has become a basic national policy in Japan.

In order to advance the development of national e-learning, Japan has successively put forward many plans such as the One Hundred Schools Project, the Space Collaboration System, and the Virtual University Plan. The One Hundred Schools Project was put forward by Ministry of Education and Ministry of Economy, Trade and Industry (MITI) in 1994. It was an attempt to set up a new type school in the highly informationized society. Through this plan, hundreds of middle schools and primary schools could connect to the Internet via special cable and telephone lines. The students could learn about and use the Internet and communicate with each other throughout Japan or even all over the world. In Oct 1996, the National Institute of Multimedia Education set up the Space Collaboration System and operated the HUB station. At the same time, 116 national higher educational institutions participating in this system set up 139 ground satellite stations. The Space Collaboration System remains one of the world's most advanced two-way audio and video educational systems. Through it, the universities in all parts of Japan and other higher educational institutes can cooperate in holding thematic lectures, group teaching and meetings by using synchronous mutual audio and video communication. This led to the development of new pattern in higher education. At the same time, Japan also implemented the Virtual University Plan. Three Japanese universities and an American university are currently exchanging courses with one another other. The students in Mie university Japan and in North Carolina University at Wilmington are able to watch Japanese movies and discuss cultural differences between the two counties through the video conference system. Students majoring in health care science in the two local public universities of Japan are nowadays taking elective health care courses offered by North Carolina University at Wilmington.

III. E-learning in China

Current Situations of E-learning in China. The Chinese government attaches great importance to the construction and development of e-learning in the country, and the leaders of the party and the country have made significant statements on the topic from time after time. Jiang Zemin, former General Secretary of the Communist Party of China (CPC), once pointed out clearly that, "Life-long education is an inevitable trend in the development of Chinese society. Traditional school education cannot meet the peoples' need to renew their knowledge. With the support of distance education networks, we will build an open education system covering the urban and rural areas of the whole country to provide all kinds of social members with multi-level and diversified education service." In the 3rd National Conference on Education, Li Lanqing, Vice premier of the People's Republic of China's (PRC) State Council, pointed out clearly, "One of four great actions to comprehensively advance quality-oriented education must be to energetically improve the modernization of educational technique and educational informationization." The government supports the construction of a modern distance education network based on the China Education and Research Network (CERNET) and Satellite Video System, strengthens the construction of the economical and practical terminal platforms and the campus networks, and fully utilizes existing resources and various kinds of audio-video methods to continue offering diversified audio-visual education and computer-aided instruction. Under the impetus of national macroscopic policies, the construction and development of e-learning have shown an accelerative growth trend. As far back as the beginning of 1998, the Ministry of Education proposed a plan named Action Plan for Vitalizing Education for the 21st Century. Implementing the Modern Distance Education Project, forming an open education network and constructing life-long learning systems have become important components of this plan. The guidelines for these policies emphasizes the government's support of distance education, and the idea of life-long learning established by the guidelines will also make the citizens of our country take advantage of distance education day by day.

In the aspect of infrastructure construction, CERNET had become a high-speed network based on DWDM/SDH by the end of 2002. It consisted of 20,000 kilometers of cable and covered nearly 30 major cities. The overall capacity of its backbone had reached 40Gbps, and the total bandwidth directly connecting to many countries and regions was more than 300Mbps. CERNET, of which the transfer rate of the backbone and the local network were respectively 2.5Gbps and 155Mbps, has connected more than 160 cities. With more than 1000 institutions and more than 10 million users, CERNET has become one of the largest broadband-internets in the world and the solid foundation of the development of e-learning in China. At the same time, Chinese telecommunication networks and television networks were also developed quickly. The total length of optical cable in or among provinces now exceeds 150,000 kilometers, and that in local telephone networks has reached 300,000 kilometers. The total capacity of data communication networks has reached to 460,000 ports. The packet switching network and the digital data network cover all major cities, 90 percent of all counties and some towns. The Internet covers 31 provinces and many municipalities and autonomous regions of our country. Recently, the China Public Multimedia Communication Network has initiated trial service in 26 provinces and cities. The Chinese Broadcast and Television system possesses a 1.9 million kilometer cable television network including more than 200,000 kilometers of optical fiber, nearly 20,000 cable TV stations, and 70 millions viewers. The Chinese Academy of Sciences has also built the China Netcom whose backbone in the gigabit range. All these developments provide a solid physical infrastructure for researching and developing the key technologies of e-learning.

To promote the development of e-learning in China, the Chinese government has organized experimental units of different forms and scales. In the September 1998, the Chinese Ministry of Education sanctioned Tsinghua University, the Beijing University of Post and Telecommunication, Zhejiang University and Hunan University to implement the tryout of e-learning by utilizing computer networks and satellite communication. By July 2000, the number of universities sanctioned by the Ministry of Education to implement e-learning had reached 25, including Peking University, Northern Jiaotong University, Renmin University of China, Beijing Foreign Studies University, Sichuan University, and Southern Yangtze University. By the spring of 2003, this figure had reached 67. In 2000, e-learning began to enter a rapid development period. The number of students who were recruited by e-learning schools had reached 65,000 by March 2001.

While higher e-learning was being developed, middle and primary e-learning relying on the Internet has also been flourishing. Some middle and primary schools have realized computers networking and some main elementary and high schools in specific cities have connected with CERNET. Statistics show that over 10 million students in middle and primary schools have mastered the basic operations of computers. In some more developed areas, various computer aided instruction and e-teaching schemes have been implemented. The expert group on the construction of information technology course in the middle and primary schools sanctioned by the Ministry of Education suggested that all senior high schools and junior high schools in cities start to offer a compulsory course on information technology from the academic year 2001, and junior high schools in other areas should begin from the academic year 2005. Primary schools in cities and the developed areas of the country will popularize information technology from the new academic year of 2005 and the primary schools in other areas will do it from the academic year 2010. The generation of students in the middle and primary schools who can operate computers and use networks are going to constitute a substantial clientele e-learning for in the future.

At present, e-learning in our country exhibits the following characteristics:

Diversification of entities running schools. The 67 universities authorized by the Ministry of Education to develop e-learning are the main force for developing Chinese e-learning. In addition, some universities abroad have also begun to set up e-learning schools to implement e-learning crossing over half of the earth, including California State University system in United States and Greenwich University in Britain. E-learning implemented by these universities includes not only academic education but also training leading to technical ability certificates. In addition, some big corporations, such as Microsoft and Cisco directly invest in setting up e-learning schools in our country leading to certifications such as Microsoft certifications and Cisco certifications, for example.

Multi-levels of e-learning. At present, there are five levels in Chinese e-learning, namely: upgrade from junior high school student to senior college student; upgrade from senior high school student to university student; upgrade from junior college student to university student; second degree and academic credential education programs; and postgraduate education. At present, there only are three universities, namely Tsinghua University, Beijing Institute of Technology, and Shanghai Jiaotong University, implementing e-learning at the postgraduate level. In addition to academic education at these different levels, e-learning is also being used for training, such as Microsoft certifications and Cisco certifications.

Increasing enrollment year by year. By March 2001, the total enrollment in Chinese e-learning programs had exceeded 240,000, consisting of 65,000 students at ordinary universities and colleges, and 180,000 in radio and television universities. By the autumn 2001 semester, the number of students had risen to more than 400,000. With the rapid development of technology, the rhythm of knowledge renewal becomes faster and faster. Most adults need further renew their knowledge further, and it is difficult to utilize only the existing educational conditions to carry on this kind of occupational training. So, the number of people accepting e-learning is predicted to increase year by year.

Problems Faced by the Development of E-learning in China. Under the impetus of national policies, Chinese e-learning has already been implemented in various degrees at different levels. However, the development of e-learning has also encountered a series of problems:

The immaturity of the theories and technologies of e-learning. As a new education pattern, e-learning should be guided by new educational theories and supported by new related technologies. However, because the development of e-learning in that is a relatively recent phenomenon, most current theories on e-learning are not finalized and are waiting for further revision and improvement according to practice. Besides, the technical problem of the implementation of e-learning is also a bottleneck restraining the development of e-learning itself. Since information technology is among the fastest developing fields, technical research on e-learning should not be confined to present technical levels but should also look to the future.

The lack of overall standards and criteria. Existing domestic educational software systems greatly promote the current development of e-learning. But, with the lack of overall standards and criteria and an integrated architecture on related technologies, satisfactory regional or countrywide e-learning systems cannot be developed to meet the needs of our country. Thus, a series of standards and criteria with regard to e-learning need to be constituted under the organization of relevant national departments so as not only to guarantee the quality of e-learning, but also it popularize on a large scale.

The lack and inadequacy of educational resources. Educational resources play an essential role in e-learning. The extent of their abundance and sharing determine the degree of popularization of e-learning. Although e-learning in China has been developed to some extent, it is still at the starting stage and the construction of educational resources remains widely weak, especially in the central and western regions. Furthermore, most educational resources either duplicate each other or have a narrow coverage, and available resources are not sufficiently abundant. Besides, existing educational resources are not shared sufficiently. The extent of the abundance and sharing of educational resources on the Internet has become one of the important factors that seriously restrict the development of e-learning in our country.

Lack of appropriate teaching software and equipment which are mostly foreign products. The implementation of e-learning requires the support of various kinds of software and hardware. At the beginning of the development of e-learning, the majority of universities and colleges adopt foreign commercial products which are very expensive. The substantial dependence on foreign software and equipment has not only restricted the development of e-learning in our country, but also has caused an enormous loss of foreign currency. Additionally, some products have certain defects related to their use and cannot satisfy the needs of the rapid development of e-learning in China. So, researching and developing the e-learning system to produce independent intellectual property will have a great signification for heightening the level of Chinese e-learning technologies.

The need to change the educational pattern. E-learning is a kind of open educational pattern, which is different from the traditional patterns. But, e-learning as currently implemented hasn't gotten rid of the influences of traditional educational patterns completely in the aspects of teaching contents, teaching methods, teaching management and teaching evaluation, so that various advantages of e-learning cannot come into full play. Therefore, we need to study new-types of educational patterns, educational methods and educational evaluation systems by implementing demonstration projects and experiments for teaching.

IV. E-learning Key Technologies and Demonstration Projects

In order to solve the problems noted above, improve the level of educational modernization and informationization, and meet the increasing demand for education in the new century in January 2002, the Chinese Government began to organize and implement the National Key Technologies Research and Development Program during the 10^{th} Five-Year Plan Period, namely: E-learning Key Technologies and Demonstration Projects, by using some advanced experiments and studying the development of patterns abroad.

Researching the Goals of the Project. During the first several years of 21st century, this project plans to utilize national manpower and financial resources, follow the guiding theory of "researching the technology, emphasizing demonstrations, and encouraging industry", relying on advanced network infrastructures such as CERNET, in order to solve the key technological difficulties currently restricting the development of e-learning in China. The project will search the patterns, standards and criteria of e-learning according with our national conditions, and research and develop a set of e-learning systems with independent intellectual property. Besides, some e-learning application demonstration projects at different levels will be implemented in order to test and estimate the implemented results from aspects such as cost and efficiency of system, validity in teaching, market flexibility, and e-learning technologies, and offer a solid foundation for constructing the whole framework of national modernized educations.

Researching the Content of the Project. This research project is conducted by several universities of our country, including Southeast University, Tsinghua University, Beijing University of Post and Telecommunication, Hunan University, and Fudan University. It's divided into 12 subjects, including seven key technologies, four demonstration projects, and a leading subject, as shown in figure 1. The seven key technologies are real-time teaching systems, non-real-time teaching systems, network teaching management systems, e-learning settlement systems, courseware producing and intelligent answering tools, exercise and examination management tools and educational resources management system. The four demonstration projects are the e-college demonstration project, the secondary school education demonstration project, the occupational training demonstration project and the medical clinical teaching demonstration project. Finally, the total design and integration of the system is the leading project.

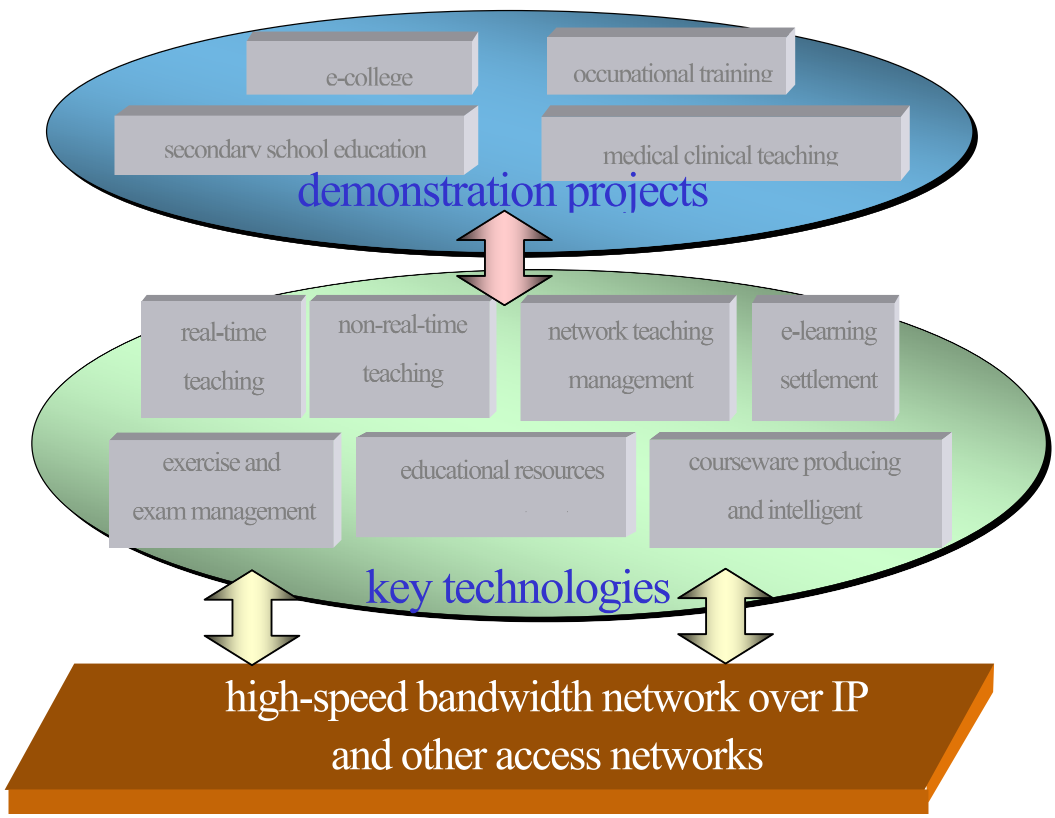

Figure1: Research Contents of E-learning Key Technologies and Demonstration Projects

Real-time teaching system. The task of this subject is to develop an interactive multimedia synchronous real-time teaching system based on IP network with independent copyrights through research on network flow technology of the teaching process, management technology of real-time teaching in-class, extensible control technology of real-time teaching, and recording and access technology of real-time teaching resources. This system will support powerful multimedia interactions and teacher's natural writing on the blackboard, offering multimode and extensible functions of cooperation and communion between teachers and students. It will adopt the multi-granularity and multi-tactic in-class management mechanisms and have the functions of multimedia real-time teaching recording, and multimedia courseware search and contents management. Finally, a set of integrated practical multimedia real-time teaching systems will be formed and applied to e-learning demonstration projects.

Non-real-time teaching systems. This subject is intended to meet practical demands in the e-learning process. On the one hand, we will research media-flow technology which can adapt to both the present and future e-learning situations, and develop MOD (Media on Demand) systems for non-real-time teaching. Related technologies include the control mechanism supporting concurrent access to mass data, media data integration with synchronization, and adaptive data transmission for any kind of bandwidth. All of these make it possible to replay the multimedia teaching content, which are made by multimedia courseware real-time synchronized developing systems in the asynchronous mode. On the other hand, we conduct research about the collaborative studying environment on-line, including: synchronized study processes, role playing in study, functions of annotation, synchronized interactive discussions, and grouping mechanisms. A flexible and effective cooperative teaching mechanism is to be developed, and an on-line exchange platform for teaching will be built by building relevant tools class, in order to promote the efficiency of teachers and the learning abilities of students, and then to promote the sharing of the resource.

Network teaching management systems. The objective of this subject is to conduct research about key technologies such as: open managing techniques of network teaching adapted to our national conditions, distributive and cooperative data exchange technologies inside and among the network teaching management systems, technologies for analyzing behavior and evaluating qualities in network teaching, design of the comprehensive functions for educational customer service centers based on IP, and network teaching management system architecture supporting concurrent mass access and multi-platform. A flexible and interoperable network teaching management system with independent intellectual property, which is specialized for China and adapted to next generation high speed Internet, is to be developed. It includes teaching service management systems, systems for analyzing teaching behavior and evaluating teaching qualities, and an educational customer service center system. Through researching and implementing this subject, the teaching management level of e-learning in our country will be promoted in all aspects and the whole process of the educational modernization will be furthered.

E-learning settlement system. In order to implement automatic accounting for on-line educational services and automatic settling between the financial department of schools and the bank, the task of this subject is developing an e-learning settlement system with the characters of accuracy, openness, generality, safety and scalability, based on the research on accounting policy for e-learning, data interface between various system, identity authentication and data encryption. E-learning settlement systems include three subsystems, which are the accounting management subsystem, the payment gateway subsystem, and the security subsystem.

Courseware producing tools and intelligent answering tools. This subject is divided into two parts, namely courseware producing tools and intelligent answering tools. First, the task of the courseware producing tool component is to study and constitute a set of standards for producing courseware, and develop the courseware producing tools consistent with above-mentioned standards for use by non-professional users such as teachers. The tools will be based on meta-data and XML technologies and have functions like simply editing pages, managing the structure tree of the courseware's contents, translating from nonstandard courseware to standard courseware, mutually calling between courseware and teaching resource libraries, capturing the learning information intelligently, and splitting and combining the dense multimedia courseware; The task of the intelligent answering tools component is to develop a web-based intelligent answering system, depending on research on how to represent, organize, store and search questions and answers effectively, and research about question matching techniques and auto answering techniques, and also about answering behavior tracking and answering effect evaluation. This system has the functions like quickly intelligent answering, searching questions, statistics and analysis of questions, and managing questions, and could be integrated with the resources management system.

Exercise and examination management tools. By conducting research on technologies of organizing and managing exercise libraries, of automatically creating and grading exercises and examinations, of managing and supervising the examination process, of adaptive examinations, and of security of on-line examinations, this subject will present a web-based multimedia tools for administrating the exercises and examinations, provide the functions of administration for the teachers and mass visiting for the students.

Educational resources management systems. This subject is intended to meet the concrete demands of administrating resources of distance education. After conducting research on key technologies on how to describe educational resources, how to connect to digital libraries with content gateways, how to organize and index educational resources by knowledge category, how to sort images by similarity, how to summarize and sort the audio and video material, and how to store mass resources based on hierarchical data management, two systems are to be developed to manage, discover and register educational resources on the Internet. The digital library and the e-learning system will share resources, and the educational resources organizing and administrating technologies with independent intellectual property will be formed to accompany the corresponding software.

E-college demonstration project. The e-college demonstration project is an integrated education system depending on network and information technologies which provides courses at the university level. This system can demonstrate any essential aspect of e-learning, including attending lectures, playing courseware, discussing, searching data, submitting exercises, and administering and taking examinations. The teachers also can use the system to lecture, answer questions, and dispense exercises. Activities like arranging courses, administrating the registration of students, and evaluating effects, are supported as well. In one word, this system is not only the platform to test various key technologies, but the window to demonstrate the impacts of e-learning.

Secondary school education demonstration project. By constructing the digital campus, establishing a united secondary school on the Internet, and setting lectures by famous teachers, the secondary school education demonstration project will provide the teachers and students with a platform for interactive and collaborative studying, and demonstrate the process of e-learning to other secondary schools. The goal is to promote the implementation of information technologies in fundamental education and cultivate students by means of the high quality of information.

Occupational training demonstration project. The objective of the occupational training demonstration project is to establish an e-learning system for occupational training, which will make it possible for employees to learn anywhere, anytime, and any subject. Effective, convenient, practical supporting tools are being developed to promote the utilization of educational resources and interaction among trainees, to meet the demand of occupational training, to seek to implement and popularize e-learning in occupational training, and to realize the perfect combination of e-learning technologies and occupational training education.

Medical clinical teaching demonstration project. The objective of the medical clinical teaching demonstration project is to develop the open web-based clinical medicine education system, a real-time evaluation and supervision system for quality teaching, and an on-line examination system for clinical medicine, all of which are based on a database including abundant typical cases and teaching materials. The system can assist teaching and learning in both the traditional education mode and PBL (Problem Based Learning) mode, and it also has functions such as collecting and sorting teaching materials on medicine, managing and supervising the process of medical clinical teaching, and evaluating teaching impacts. This subject will provide junior and senior interns with rich and valuable reference materials.

The total design and integration of the e-learning system. This objective of this subject is to study strategies of e-learning and relevant interface standards and, finally, offer a flexible and interoperable system integration platform meeting the needs for developing e-learning in the new generation high-speed Internet environment. The seven key technologies will be integrated into the four demonstration projects in order to form an organic and dynamic e-learning system suitable for China's national conditions.

Expected Achievements of the Project. Through researching and developing the key technologies of this project, the following achievements are anticipated:

1) Solving a batch of advanced and applicable key technologies of e-learning, including network multimedia technology, the management technology of e-learning, the object's behavior auditing technology, the data mining technology, payment technology for e-learning, multimedia courseware producing technology, self-adaptive multimedia accessing technology, and system integration technology.

2) Offering a batch of supporting systems with independent intellectual property for e-learning, mainly including the network teaching system, e-learning management system, the e-learning supporting tools and the e-learning resources management system. Based on those key technologies obtained in the research of this project and other advanced technologies, these systems will solve general and difficult problems of e-learning in our country, raise the percentage of software and hardware with independent intellectual property in the whole e-learning system, and further promote the formation and the development of the educational information service industry and educational software industry.

3) Setting up four kinds of application demonstration projects and popularizing them. At a later stage of this project, four kinds of application demonstration projects will be set up, including e-college, secondary school education, occupational training, and medical clinical teaching. Through the construction of the demonstration projects, those tools and systems mentioned above will be used in e-learning. And a set of schemes about how to popularize these systems will be concluded based on China's national conditions. This will promote the integrated application engineering level of e-learning across-the-board and make our country have a leap-type development in e-learning field.

4) Cultivating large quantities of e-learning technicians. Through researching and developing the key technologies of this project, a group of high quality experts with high-quality familiar with the information technologies relevant to e-learning and education technologies, will be cultivated. These persons will have the ability for further development of e-learning in our country.

V. Development prospects for E-learning in China

Although e-learning has only recently been born in China, it has been energetically supported by the government's policies and has also absorbed certain software and hardware environments. So e-learning has enormous potential markets and obvious benefits of scale. With the implementation of the E-learning Key Technologies and Demonstration Projects, the development of e-learning has a bright prospect in China, and some new characteristics and changes will appear in Chinese e-learning in the near future.

The overall arrangement of e-learning will be more rational and its structure will be more ideal. For a variety of reasons, the development of e-learning in the eastern coastal areas of our country has already far exceeded that in the midwest. With the development of e-learning and the scope of national policies, relevant universities and economic entities in the eastern coastal areas will provide the midwest with distance education gradually, and midwestern e-learning will also gradually play a more important role. Additionally, educational management, teaching materials, teaching methods and learning ability will be improved further with the expansion of e-learning. When the time comes, e-learning systems with ideal structures and rational arrangement will cover most areas of our country, and e-learning in our country will enter a healthy, orderly and harmonious period of development.

E-learning will play a more important role within the whole educational system. Although the establishment of courses for Chinese e-learning will still rely mainly on the applied and technical courses in the next 20 years, some organizations and individuals will offer some theoretical and experimental results to improve the content and technology of e-learning. This will impel the whole educational system of e-learning of our country to increase substantially. When the time comes, e-learning will attain an appropriate balance with self-taught and traditional university education. These three kinds of education will permeate, complement and perfect each other further on the basis of keeping each interdependent to form a more rational and perfect national education system.

E-learning will be popularized gradually. With the high-speed development of technology, the rhythm of knowledge renewal becomes faster and faster. Most adults need to renew their knowledge further and it is difficult to utilize only existing educational conditions to carry on this kind of occupational training. Because e-learning breaks space-time limits and has better openings, this means that adults can fully utilize free time to study the online courses by way of self-study. Besides, with the development of modern multimedia technology, the cost of various kinds of multimedia facility and communication expenses will be reduced to a degree that most common people can bear. When the time comes, people will dispel the strange feeling and prejudice regarding e-learning and treat e-learning calmly and objectively This kind of attitude will permit e-learning to develop in a normal, healthy and orderly direction.

E-learning will profit from an obvious benefit of scale. The rapid development of e-learning in China not only benefits from the government's policy support, from possessing some software environment, and from huge educational demands, but will also from its own benefit of scale. Because of the huge market demands, implementing e-learning tools can result in profits and the market can get involved in e-learning. When the time comes, different kinds of entities implementing e-learning in our country will tend to the combination among the strong ones, and e-learning will become the competitive product of the educational industry and the bellwether of educational marketization.

VI. Conclusions

As human being entered the 21st century, the renewal of knowledge changed with each passing day and international competition became increasingly fierce. Competition between countries measured in terms of overall national strength of various countries will be embodied in human talent. And the key to talent cultivation is mainly education. Because society in the future will require higher qualifications for laborers in future, the target of education will undergo an essential transition. Besides traditional school education, continuing education and life-long education will become a necessary part of future society. As far as Chinese education is concerned, e-learning based on information technology is not only a challenge but also an opportunity. According to the actual conditions of China, developing e-learning energetically and improving the whole people's cultural endowments can turn the heavy population burden of our country into the advantage of manpower resources. The development of e-learning can be regarded as a set strategic actions through which our country can realize the strategy of prospering the nation with science and education, raise overall national strength, and keep the persistent and stable development of the social economy. These factors are also the only way for improving international competitiveness under the conditions of the economic, scientific and technological globalization.

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Information Distribution and Concentration in Science Information on the Network
– "Tacit Information" and "Digital Information" –

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I. Scientific Information Network

In the field of scientific research, sharing information via the network has been developed for some time. Scientific information sharing is shifting from the physical exchanges of the paper-based information possessed by the library to the direct accesses to the information kept electronically. By the development of this measure, information anywhere in the world can be accessible from anywhere else in the world.

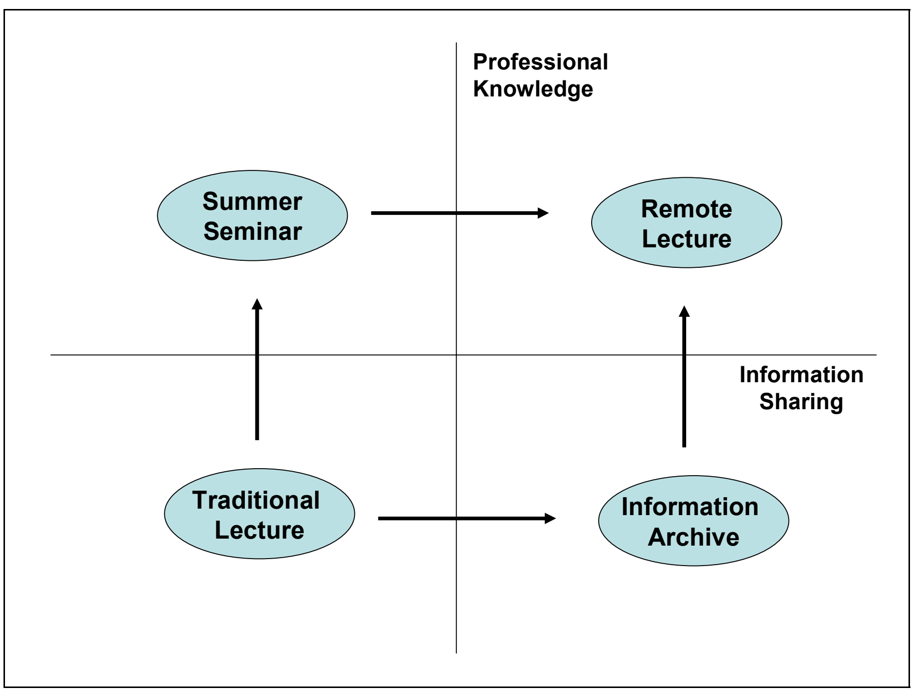

Figure: Forming Conditions of Remote Education

II. Educational Information Sharing

The information accumulated in distributed scientific research networks can be utilized as teaching materials for remote education. Taking institutions of higher education as an example, information and human resources used to be held within geographically distributed universities. Lecture content was created and kept in each university or by the teacher. When one wished to use that content or scientific information, such as papers and technical books, they were physically moved between institutions or libraries. Information sharing costs were high, and scientific information was distributed, or fragmented.

When a lecturer's specialty and scarcity is high enough, and the cost sharing of scientific information is high, it is efficient to move those talented people for such activities as an intensive course. This is because the scientific research level as the whole improves with the concentration and specialization of talented people rather than distributing them to each university. Since the cost of such specialized information was high, remote education did not materialized in this stage. If the cost of sharing scientific information becomes low, the efficiency of the lecturer in each university can be increased by sharing lecture contents. In this framework, two or more universities separated geographically share the scientific research network as an information platform, and the scientific information database as information content.

A large-scale investment is needed for the construction of such an information platform. When a private sector supplier does not appear, a participating university develops a consortium and constructs the platform. When a consortium cannot be developed, an inter-university research institute provides a scientific information infrastructure. By utilizing an information platform, each university can share scientific information inexpensively, and highly specialized lecture can be offered in every university. A lecturer's specialty and scarcity are high, and when the sharing cost of scientific information is low, the value of remote education increases.

In order to attain a quality of comprehension comparable to a lecture in a classroom it was not enough to transmit a lecture to a remote place; new technology needed to be developed. Development of information network technology made this possible. Construction of an international broadband circuit and development of education management software enabled the international remote lecture to be transmitted with quality near the level of a face-to-face lecture. In an international remote lecture, a sending university gives a lecture towards the receiving university overseas through an international ISDN circuit.

Being able to perform a lecture live and in both directions, a lecturer receives a question from the student of a receiving university during a lecture. The students utilize the education management software, and access the server via the web on which data and the report are put. The actions which each student carries out on education management software is recorded on the web server. The lecturer can check a student's degree of study achievement and can provide each student with a study plan.

In 2002, Osaka University and the Thammasat University Remote Educational Project (abbreviated-name HIIT Project) was carried out between the Kingdom of Thailand and Japan, where the lecture at each time was transmitted to Thailand from the classroom in Osaka through the international ISDN circuit (access speed 128Kbps)[4]. The education management software WEBCT kept a record of what kind of interaction a student followed, and provision of the conditions such as Proceed to Subject 2 after finishing a Subject 1 was also possible. By sharing information about study progress between a sending university and a receiving university, it became possible to perform the same kinds of lecture quality as in face to face situation though it was a remote place.

If the international remote lecture system improves in quality and becomes widely used, everyone who has a specialty can send highly specialized lectures to the world. Consequently, the international research level will be improved by the result of refined specialization, and it is expected that the students will have a wider scope in content selection.

III. View of the Scientific Internet

There are two points that explain why remote education is attracting attention. One is the range of shared information was expanded by the development of a communication network. The other is the increasing motive to reexamine the way of concentrating and distributing specialized information.

The system which takes one point concentration, as was seen in urbanization policy, and accumulates all the information and all the resource for judgment to a single university headquarters became less inevitable.

[4] http://www.osipp.osaka-u.ac.jp/thai/index-e.html

As the scope of information sharing increases, research and education will be improved in every possible aspect, and the social structure will be transformed to the most desirable point where concentration and distribution can keep in balance.

It is required of those who provide such kinds of services that they remain conscious about where the focal point is in order to keep this delicate balance.

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Open Source for Our Information Society:
The Impact of Externality, Linux

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I. Introduction

Today when we access to the Internet, we use open source software. The most popular web server software is Apache that can be operated with secure software OpenSSH. Your mail server would use sendmail or qmail. These are defacto standard open source software used on the Internet.

Now we *can* construct all sets of information systems with purely open source software instead of common pay-soft like Windows, Oracle, and MS Office. Table 1 is a proposal for a basic information system. We don't say all of the information system in the world *should* be transposed to open source software but say you have various options other than using the packaged software of Microsoft or some other huge software company.

	Open source software
OS	Debian GNU/Linux, FreeBSD
GUI	X Window, KDE
Web Server	Apache
Mail Server	sendmail, qmail
Security	OpenSSH
Database	MySQL, PostgrSQL
Script language	PHP, Java
Web Browser	Mozilla
Office Tools	OpenOffice, K Office, Gimp, magic point

Table 1 a proposal of a basic information system

As Economides and Salop note, complementary goods tend to have different types of competition in terms of perfect competition concepts of economic theory[1]. In other words there exists a so-called lock-in[2] effect between an operating system (OS) and software. This means if you have a

[1] Economides, N. and Salop, S. C. Competition and Integration among Complements, and Network Market Structure, Journal of Industrial Economics 40.1

[2] Shapiro, C. and Varian, H. R. Information Rules: A Strategic Guide to the Network Economy, *Harvard Business School Press*

significant share of platform goods, like OS or a CD player, you can easily get other component goods, like browsers or CD media. But if you use open source software, you can avoid adverse effects of the monopoly or a strong lock-in effect with a possible lengthy fight in court[3] because you have a free hand to switch software without paying an extra fee, and because you could check the software for its source code if you desired to do so.

Now we will investigate open source software from the perspective of externality.

II. GPL[4] on Linux

Linux was announced on August of 1991 by Linus Torvalds[5] and it continues to be constructed. In 2001 he said that there were some million users and some thousand developers[6]. Now it is even used for mobile phones, Play Station, or cogeneration systems as an embedded OS.

There are various analyses[7] on the success of Linux in the aspect of technology or social activities. In Japan Sasaki and Kitayama say the success of Linux is its unique distribution model; an alliance between the community and distributors[8]. Yonemochi[9] add the importance of the huge investment by computer venders[10] and software venders. Shapiro and Varian[11] and Lessing[12] have pointed that strongly protected intellectual property rights can have negative impacts on innovation.

Two significant papers by R.H. Coase are The Nature of the Firm[13] and The Problem of Social Cost[14]. The former paper is famous its discussion of the idea of transaction cost. This idea as it applies to Linux is discussed by Benkler[15]. Here we focus on externality, the idea discussed in the second of these papers by Coase, not transaction costs. Linux is adopting GPL for distribution.

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[3] You can find it everyday in web techno-news site like http://www.zdnet.com/ or http://www.wired.com/.
[4] GNU General Public License. See http://www.gnu.org/copyleft/gpl.html
5 Torvalds, L. and Diamond, D. Just *Fun: The Story of an Accidental Revolutionary*, Harper Business
[6] Torvalds, L. The Linux Edge, Dibona, C et al. Ed, *Open sources: Voices from the Open source Revolution*, O'Reilly & Associates
[7] Raymond, E. [1997] "The Cathedral and the Bazaar" is one of famous ones. See http://www.catb.org/~esr/writings/cathedral-bazaar/
[8] Sasaki, Y. and Kitayama, S. Expanding Linux's value through Community Alliance Strategy NTT Publishing
[9] Yonemochi, Y. *Open source Business* Nikkei BP
[10] IBM is the world's largest investor in Linux.
[11] *op cit*, ref. 2
[12] Lessing, L. *The Future of Ideas: the Fate of the Commons in a Connected World*, Random House
[13] Coase, R. H. The Nature of the Firm, *Economica 4, 1937*
[14] Coase, R. H. The Problem of Social Cost *Journal of Law & Economics* 1, 1966
[15] Benkler, Y. Coase's Penguin, or Linux and the Nature of the Firm *Yale Law Journal* 112, 2002

GPL was originally made for R.M. Stallman's GNU[16] Project[17]. While GPL is very similar to the open source[18] idea, there is one critical difference between them; namely: the inheritance of the GPL. If you modify software under licensed by GPL, you must make your revised program open to the public. So the original software is copied, distributed, and modified without any cost. This means it can easily be transmitted anywhere and to any place.

This easy transmission of source code has large externalities[19] because it's something akin to public goods, which are character by its non-excludability and its non-rival ness[20], while open source software never excludes any use by anyone and can use at the same time by anyone. So open source software is a kind of non-exhausted public goods. While in the case of the tragedy of commons public goods are over consumed or congestion occurs, this is not the case with open source because of there are no limitations on its transmission. So its use does not carry negative externalities

On the supply side once its users or supporters provide feed back to the developers' community, the development itself progresses without additional costs. In a sense open source project is an experiment in a no intellectual property rights world where all knowledge work is shared used effectively. Some of the fruits of such development would come to be incorporated significantly into specific software such as Apache or Sendmail.

To understand this process in more depth, consider the history and strategies of Linux distributors.

III. The Genealogical Tree and Strategies of Linux

Here we will categorize various Linux distributors by their binary packaging method. On Linux, software is managed by a packaging unit, treated as an object. So managing systems determine a kind of interface for each of Linux's distributions.

One of the most famous packagings, deb package, is made by Debial GNU/Linux and from its

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[16] GNU(GNU's Not Unix) is a series of UNIX compatible software development projects of Free Software Foundation.
[17] Stallman, R. M. Free Software, Free Society: Selected Essays of Richard M. Stallman, Free Software Foundation, 2002
[18] http://www.opensource.org/docs/definition.php. The Open Source Definition (Version 1.9) 1. Free Redistribution, 2. Source Code, 3. Derived Works, 4. Integrity of The Author's Source Code, 5. No Discrimination Against Persons or Groups, 6. No Discrimination Against Fields of Endeavor, 7. Distribution of License, 8. License Must Not Be Specific to a Product, 9. License Must Not Restrict Other Software, 10. License Must Be Technology-Neutral
[19] Suematsu, T. *Kyoto Style Management – Modulation Strategy,* Nippon Keizai Shinbunsha, 2002
[20] Samuelson, P. A. The Pure Theory of Public Expenditure *Review of Economics and Statistics 36, 1954*

Maintainers' Guide[21], it defines seven important categories of information for packaging: Depends, Recommends, Suggests, Pre-Depends, Conflicts, Provides, and Replaces. These descriptions of relationships are useful to change or replace objects while keeping other functions. In short the compatibility of packaging decides the compatibility of the software.

The packaging of Linux is divided into categories including: deb packaging, rpm packaging, and other packaging. We group Linux into three categories.

Deb Packaging. Deb packaging, as previously noted, is named after Debian/GNU Linux[22]. In this family there is KNOPPIX[23] in Germany, Demo Linux[24], in France, and a freak, Towns/Linux[25] in Japan for FM Towns of Fujitsu.

Since KNOPPIX and Demo Linux are localized into Japanese by the National Institute of Advanced Industrial Science and Technology, these distributions are not commercial based but community based, like Debian, the most radical GPL-centered distribution.

Rpm Packaging. Red Hat Packaging Manager (rpm) Packaging was originally developed by RedHat Linux. Most commercial Linux distributors use it. This family includes: Miracle ***Linux***[26] of Oracle Japan, Mandrake Linux[27] in France, Kondara MNU/Linux, Vine Linux[28], in Japan, Hancom Linux[29] in Korea, Red Flag Linux[30] in China.

United Linux members, SUSE Linux[31] in Germany、Conectiva[32] in Brazil , Turbo Linux[33] in US and Japan, SCO (former Caldera Open Linux)[34] are also adapting rpm packaging. In addition most of all embedded Linux such as Hard Hat Linux[35]of Monta Vista and Laser5[36], Linpus[37] in Taiwan,

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21 http://www.debian.org/doc/maint-guide/
22 http://www.debian.org/
23 http://www.knoppix.org/
24 http://www.demolinux.org/
25 http://www.st.rim.or.jp/~shindo/
26 http://www.miraclelinux.com/
27 http://www.linux-mandrake.com/
28 http://vinelinux.org/
29 http://kr.hancom.com/
30 http://www.redflag-linux.com/
31 http://www.suse.de/
32 http://www.conectiva.com/
33 http://www.turbolinux.com/
34 http://www.sco.com/
35 http://www.mvista.com/
36 http://www.laser5.co.jp/
37 http://www.linpus.com.tw/

or Shikigami[38] in Japan are based on RedHat compatible packaging.

Others. Old Linux distributions like SLS Linux、 Slackware[39] and Plamo Linux[40] use TAR Ball (tar+gzip) packaging. This is same packaging as UNIX or BSD.

To summarize the characteristics of packaging can be classified into two big waves. One is *deb* or *TAR Ball*, and these are community based or academic based Linux packages. On the other hand *rpm* is a more commercial based Linux. The *rpm* family can be divided by three types of distribution: RedHat compatible, United Linux, and customized or localized Linux. (See Figure 1.)

It is possible to compile compatible software within a given family, but that would be very difficult if one tried to cross families. If the software were to be served in binary, which is often the case in Windows and MacOS, one would have to import and remake software from another OS but remaking it, so that the switching costs would be high.

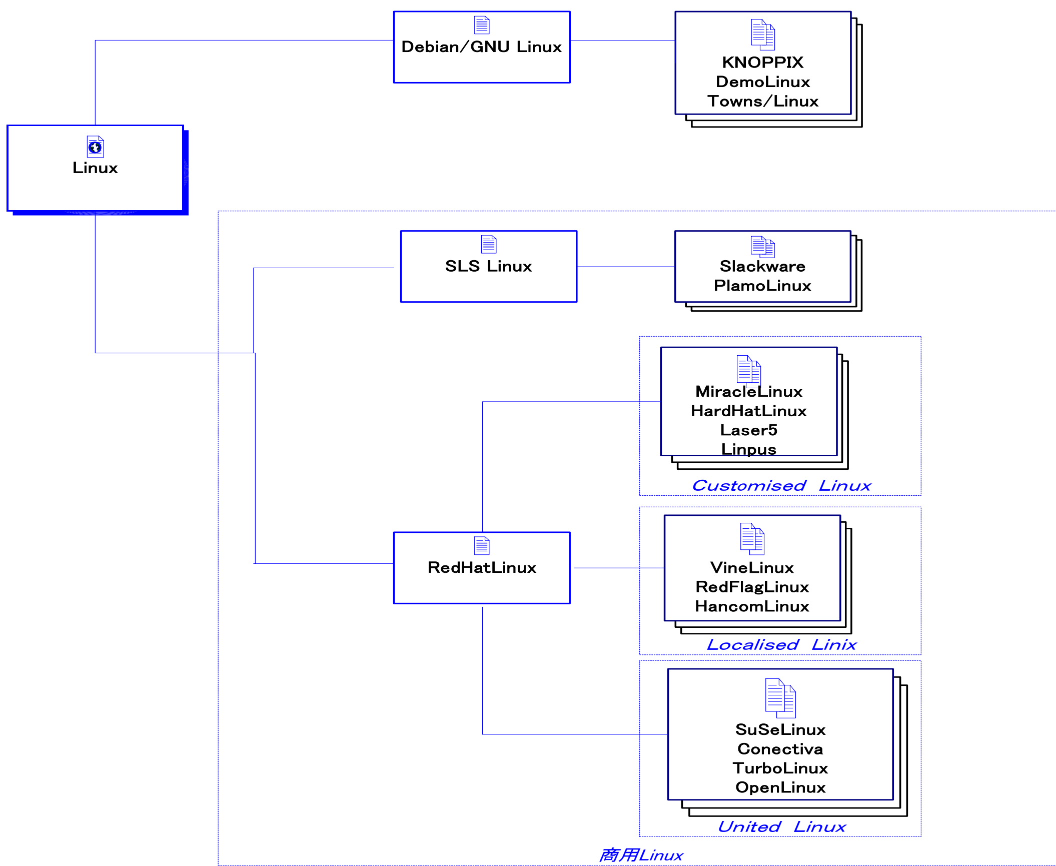

Figure 1 the Genealogical Tree of Linux

[38] http://www.sikigami.com/
[39] http://www.slackware.com/
[40] http://www.linet.gr.jp/~kojima/Plamo/

A quarter of century ago there was an open source movement in the world of UNIX.[41] It was not widely developed because versions of UNIX differed by vender and software that would have made these different systems compatible was lacking. There is a similar incompatibility problem[42] with OS in general. But Linux avoids this kind of problem because of the existence of GPL and compatible packaging systems.

Currently, Linux is used everywhere: in client PCs, servers, mobile phones, even in industrial machines and large-scale systems. Potentially Linux could be used in processing or communication modes. Table 2 shows the rival OS of Linux in Japan. The most distinct point with respect to other countries is the diffusion of Japanese original OS, TRON[43]. Microsoft[44] announced on September 25, 2003 that it would cooperate with TRON in developing information appliances. This news was a great victory for Linux, since it avoided a possible legal battle with Microsoft.

	computer				
	server		client machine		
	system	work station	PC	PDA	mobile phone
rival OS				Palm etc	JTORON etc
	unique OS				
		Windows NT	Windows	WindowsCE	
	UNIX				
	UNIX				
		CTRON	ITORON etc		
	unique OS				
	industrial machine			POS, game machine, information appliance	communication board
	embedded				

Table 2. Rival OS of Linux in Japan

IV. Conclusion

This paper has reviewed the impact of the externality of Linux and has found that packaging systems are very important for compatibility. This externality of Linux would be better suited for embedded OS. This means that we can use Linux and other open source software without violating intellectual property rights. So we should know the mechanism of open source activity, whose maxim is very different from that of the classical economic individual.

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[41] Salus, P. H. *A Quarter Century of Unix,* Addison-Wesley Publishing Co., 1994
[42] Shy, O. *The Economics of Network Industries,* Cambridge University Press, 2000
[43] http://www.tron.org/
[44] http://www.microsoft.com/

Where is the "Happiness" on the Internet?*
– "Cyberized and Civilized" "Convenient and Conventional" –

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I. Introduction

The advent of the Internet is certainly changing our lives. The Internet creates a cyber world that connects people living far apart in different countries. Communication in the cyber world has become inexpensive and richer than ever. We can virtually "feel" no difference between chatting with the person sitting in the next room and one on the other side of the planet. The Internet is useful and practical. Some argue that the Internet is nothing more than a tool. However, I feel something in the Internet that is more than that. The argument of the Internet as a tool is correct, yet we should remind ourselves what a tool had brought to the society and had influenced its transformations. Steam engines were one of the important foundations of the Industrial Revolution. The source of energy changed, transportation changed, the way of production changed, the ownership of the production changed and governance changed. In short, our lives were totally transformed by the invention of the Steam Engine–a mere "tool." Revolutionary tools bring a huge impact on society, and the Internet is a revolutionary tool.

Revolutionary tools tend to be perceived as those that work for the betterment of the human society. The question is: Is the Internet really so? People have discussed new characteristics of cyberspace as when Howard Rheingold published *The Virtual Community* in 1993[1]. The Internet would promote democracy. Now, Rheingold claims in his *Smart Mobs* that mobile Internet is a locomotive for democratization[2]. The Internet seems to be working for the betterment of human society by advancing a democratic nature. Is this really what we are gaining from the Internet? Techno-stress has become a pressing challenge for those who work in and out of the cyber society. Crimes that had never involved local communities are spreading into rural areas. I would like to raise a doubt that we may be losing something more important than what the Internet can present us. Are we really happier than before?

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* Based on a PowerPoint presentation made by Uesugi in his capacity as discussion leader of Informal Session IIIB.
[1] Rheingold, Howard, *The Virtual Community*, MIT Press, 1993.
[2] Rheingold, Howard, *Smart Mobs: The Next Social Revolution*, Perseus Publishing, 2002.

In order to look at this issue, I would like to use Four C's; namely, Cyberization[3], Convenience, Conventional and Civilization. By using these Four C/s, I would like to raise a question, which is open to answer: Do we pursue 'Happiness' in the Internet?

Before starting the illustration and question, let me look back at the ideas presented in this seminar that led me to raise this question.

II. Inspiration from the Seminar.

Smaller world. Thanks to the technology of the Internet, we enjoy the benefit of working in a smaller world. The ease in scientific research collaboration is certainly accelerating. Chinese colleagues showed the Chinese situation where many database are undergoing an integration process. Many of them are freely accessible by researchers.

Collaboration among researchers of AI3, which was illustrated by Suguru Yamaguchi, indicated how far and deeply the Internet has bound people together[4]. The infrastructure's developments have induced foreign direct investment in information and communications technologies (ICT) in many countries. All this has happened and will continue to happen with the help of, and for the development of, the Internet. These examples are evidence that the Internet is a good tool for the betterment of human society.

One world? Since the daily use of the Internet had been embedded deeply into our life, it is recognized as infrastructure. (Actually, the ICT infrastructure was ready when the Internet became indispensable.) By the same token, the more our lives have become involved with the Internet, the more concerns have been raised. For example, there are situations where costs of contents are so prohibitingly expensive that potential users may literally give up. On the contrary, for scientific researchers as Paul Uhlir pointed out, ambiguity of ownership prevents useful databases from the integration because of the inexistence of reasonable cost recovery means[5]. It seems to me that though the Internet is working to create one world, our society is not responding accordingly.

The "Hamburger vs Roppongi World" model introduced by Masao Sakauchi taught me that we are living in an era where a simple belief in the Internet is not sufficient[6]. It is in parallel to the

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[3] *Cyberization* is mentioned in the presentation of Gordon Bell (http://research.microsoft.com/acm97/gb/sld040.htm). I use this term as the one which does not have particular relation to his use.
[4] The text of Yamaguchi's presentation appears in Section IIC.
[5] The text of Uhlir's presentation appears in Section IIC.
[6] The text of Sakauchi's presentation appears in Section IIB.

problem of the widening digital divide, a major topic of information summit which recently concluded in Geneva. In my neighboring towns and villages also, low investment is a problem. Even though the quality of life has become heavily dependent on the Internet infrastructure, skewed investments are widening the gap between those who have and have not. Ironically, at the same time, those who have are feeling fear of losing their own traditions under the name of globalization. During one of the discussions at the seminar, Geoffrey Bowker pointed out the reality of the widening digital divide in the observation about the increasing concentration in the city. Though liberation from geography through the Internet was predicted to bring decentralization, centralization to the city is being propelled.

Can and Cannot. The discussions at the seminar illustrated the cans and cannots of the Internet. International collaborations and distance educations are certainly the "cans." However, the followings were the indication of "cannots." Joan Sieber expressed her observation about the significance of the value in face-to-face communications. Communication via the Internet cannot be the alternative to face-to-face gathering (that is why this seminar was held, I suppose). Hisako Koura warned the loss of sense of place in the cyberspace[7]. Does the Internet community deprive us of a sense of place? The metaphysical nature of cyberspace cannot attain entailment of humankind's corporeal nature. Toshihiko Hayashi suggested cognition processes, as well as capabilities such as taste and feeling, where the Internet cannot succeed in communicating information. While information is perceived by the receiver and is transformed into knowledge, the condition of receiver affects the cognitive process, even though it is not constant at all. Then how can we be sure that communication over the Internet conveys sufficient information? In all, as Wesley Shrum said in one of the seminar discussions, in order to stay healthy, we go back to beach.

I know some of the things that the Internet can do and cannot do. Now I would like to discuss those pros and cons in relation to the happiness with the Internet.

[7] The text of Koura's presentation appears in Section IID.

III. What is "Happiness"?

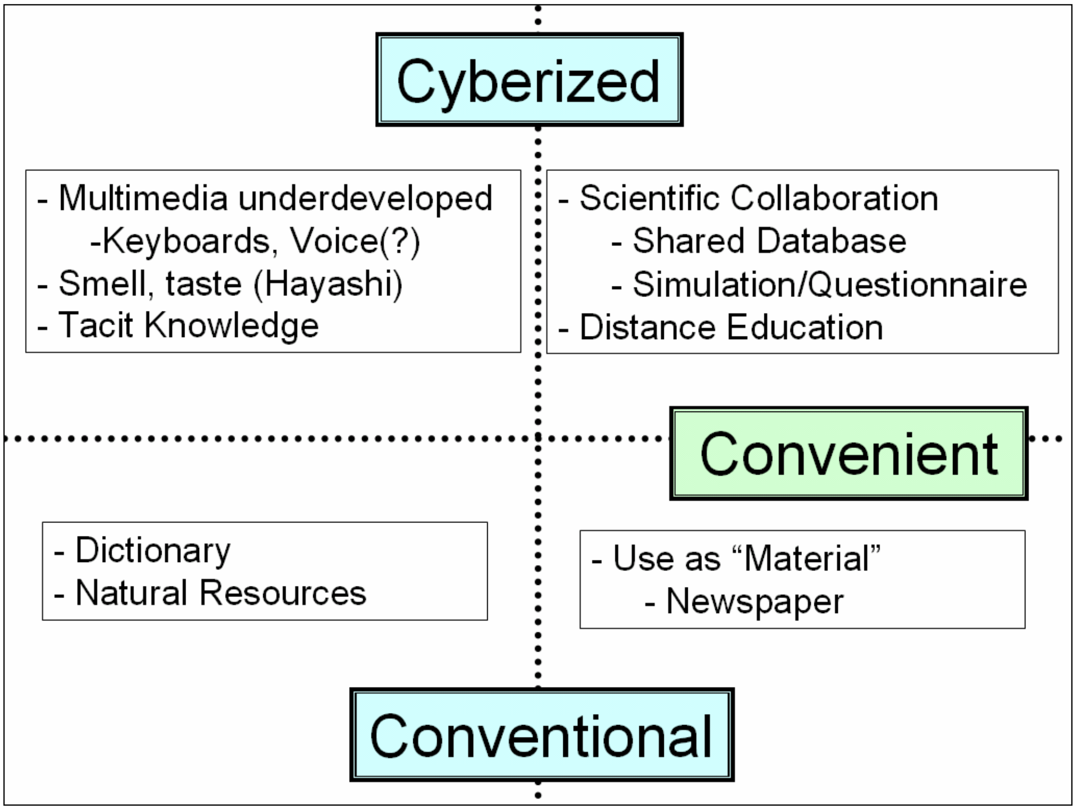

Fig. 1 The Four C's

Fig.1 is intended to explain the Four C's. On the basis of discussions at the seminar, I have picked up on the Internet's nature of Convenience and set it as the horizontal axis, which divides the Cyberized plane from the Conventional plane. For example, scientific collaboration within the Cyberized plane is convenient, whereas use of keyboards is not as convenient as the use of pens and pencils.

How about tacit knowledge? (Fig.1, 2nd quadrant) Is it more convenient to use cyberized techniques? The conventional newspaper is more convenient than that on the net when we light the fire in the fireplace. (Fig.1, 4th quadrant) If we look at dictionaries, however, a conventional dictionary is heavy and the use of paper is not as ecologically friendly as a cyberized electronic dictionary. (Fig.1, 3rd quadrant)

What I would like to share via this picture is the idea that cyberization does not always promise convenience even though, in many cases, it does provide us more convenient means than conventional means. Knowing these properties of the Internet, we may examine it further so to propose a better design of cyberspace. The Internet is a useful tool and could be a more powerful tool for social transformation than we have ever had before. We should utilize it for the betterment of human society as with other useful tools. With what scale we can measure the degree of betterment? One possibility is our "happiness. Are we happier than ever with the help of the Internet?

As I raised this question, one of our Chinese colleagues asked, what is the definition of happiness then? Indeed, "happiness" depends on what aspects of our lives are given importance by different people with different standards. I use the word "happiness" in line with the Merriam-Webster definition as "a state of well-being and contentment."[8]

Suppose we are benefit from the utility of the Internet, such as the online dictionary, and feel free from carrying a heavy chunk of paper. We are happy, aren't we? In cyberspace, people can share knowledge, can participate in communities without feeling the disadvantage of geographical location. People are happier than before, aren't they?

Following this line of the argument, the "happiness" that the Internet brings tends to be seen located on the first quadrant of Fig.1, i.e. the Cyberized and Convenient plane. If so, and if it is the only way that we conceive of our happiness with the Internet, should we always be connected to the Internet in order to be happy? What about freedom from the Internet? What happens for those who do not want to connect? I raise this proposition for the sake of discussion, and no one (I hope) will proceed in such a direction.

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[8] Merriam-Webster Online (http://www.m-w.com/cgi-bin/dictionary?va=happiness)

IV. Axis of Happiness—an Open Conclusion

Happiness involves many dimensions, while the Internet strives for faster connections, richer contents and more ubiquitous use. Then what directions should the Axis of Happiness should be drawn? In Fig.2, I described a chain-line marked by Civilized&Happy with a swirl. I intended to make this chain-line represent the Axis of Happiness. It may go toward the first quadrant where

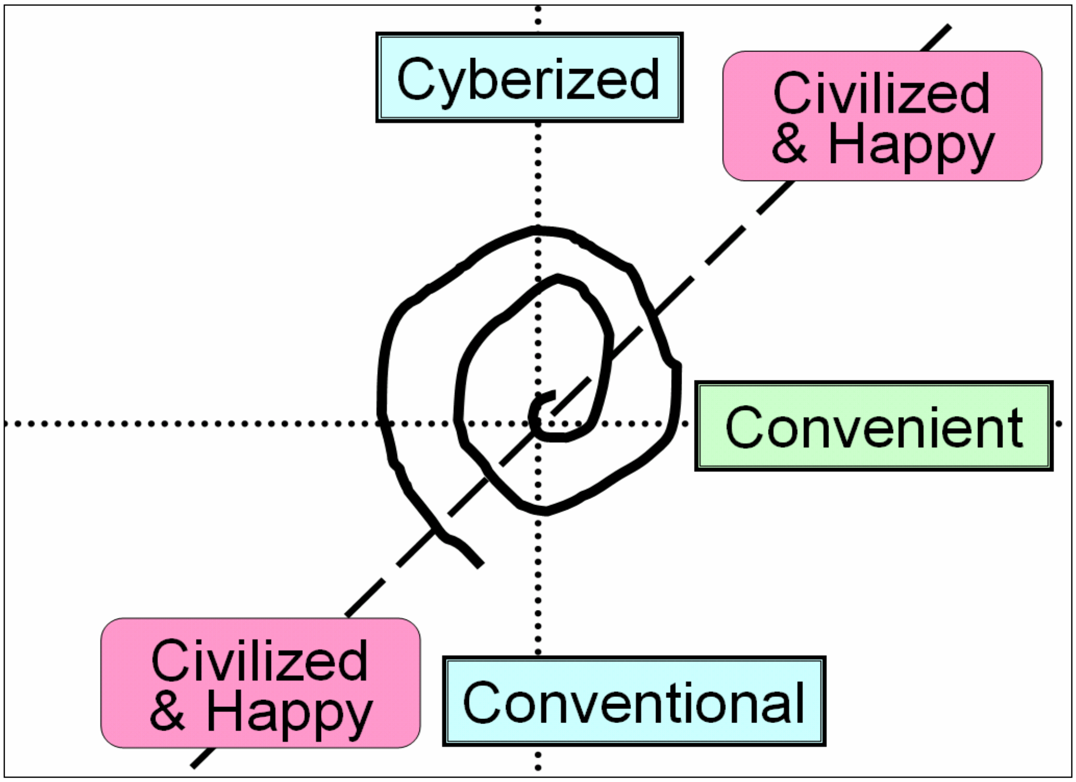

Fig. 2 Axis of Happiness

cyberization attains convenience. On the other hand, some people may feel happier without any cyber connectivity. A computer network guru expressed his joy of farming, and he declared that the Internet had not seemed to make him happy[9]. In his case, the Axis of Happiness may go toward the third quadrant. As many of the seminar participants expressed, the Internet is far from perfect. There is a lot of room for improvement from the perspective of social implications as well as from that of technological improvements.

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[9] Hiroshi Mano m President of Root Inc., at Kyoto Conference on December 5, 2003. The web site of Root Inc. is http://www.root-hq.com/e/index.html.

Why have I introduced the word civilized? Because, from my understanding, the Internet is best used for the creation of happiness by means of advancing civilized society. In other words, the axis of Civilized&Happiness involves creating the dimension of Four C's thusly: the Internet should evolve as a revolutionary tool which promotes the happiness of the human beings.

Scientific Collaboration to Combat Terrorism

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I. Introduction

Nations around the globe, including Japan and China, have joined the United States in the war on terrorism. Special measures have been enacted to provide higher levels of security, enhanced law enforcement powers and intelligence capabilities, and increased funding of scientific research on countermeasures. The post-September 11 environment has also raised new questions regarding national security and open scientific communication.

During the Cold War, the U.S. Defense Department proposed restrictions on: (1) the dissemination of certain unclassified research, and (2) access by foreign nationals to sensitive research facilities and campuses. Opposition from the academic community was so strong that the proposed controls were not enacted. In 1982, due to concerns that Soviet scientists were obtaining information through conferences and scientific literature that would help them boost their weapons systems, a National Academy of Sciences Panel on Scientific Communications and National Security was convened to address the issues surrounding restrictions on scientific communication. Significantly, the Panel concluded that whatever gains the Soviets had made, they had not been derived from open literature and that national security interests of the U.S. were better served by open scientific collaboration than through secrecy. President Reagan acted upon the Panel's recommendations by issuing National Security Decision Directive 189 (NSDD-189), which stated that:

> *[T]to the maximum extent possible, the products of fundamental research remain unrestricted. It is also the policy of the Administration that, where the national security requires control, the mechanism for control of information generated during federally-funded research in science, technology and engineering at colleges, university and laboratories is classification.*[1]

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1 National Security Decision Directive 189, "National Policy on the Transfer of Scientific, Technical and Engineering **Information," http://www.fas.org/irp/offdocs/nsdd/nsdd-189.htm.**

Terrorist attacks, however, have awakened this issue in the U.S., resulting in suggestions that "sensitive" scientific communications should be restricted and that controls should be placed on foreign students' ability to study in certain scientific subject areas and participate in research. In 1994, the U.S. State Department, at the direction of Congress, developed a "Technology Alert List" of 16 subjects that students from countries identified as "state sponsors of terrorism" should not be admitted to study.[2] More recently, President Bush reaffirmed this policy in the October 29, 2001 Homeland Security Presidential Directive, Combating Terrorism Through Immigration Policies (HSPD-2).

Additionally, restrictions on access to certain hazardous biological agents were enhanced in new terrorism laws, the USA PATRIOT Act and the Public Health Security and Bioterrorism Preparedness and Response Act. On March 18, 2002, the White House issued a memorandum to the heads of U.S. government departments and agencies instructing them not to "disclose inappropriately" government information on weapons of mass destruction "as well as other information that could be misused," creating a category of "sensitive but unclassified" information. Last year, the Department of Defense proposed to restrict scientific publication, but withdrew the proposal after a firestorm of criticism.[3]

The notion of mandated government restriction on certain scientific publication has not, however, been abandoned. The Science Committee of the U.S. House of Representatives held hearings on October 10, 2002 to explore the issues surrounding openness and scientific secrecy. Chairman Sherwood Boehlert opened the hearing by declaring:

> *As everyone here knows, I am fond of pointing out that "the war on terrorism will be won in the laboratory just as much as on the battlefield." I've made that line my byword to argue for a well organized, well staffed and well funded scientific enterprise. But the sentence also highlights some critical tensions that the war on terrorism has brought to a head. For if the laboratory is a theatre of war, then what are its rules of engagement? War demands secrecy; science thrives on openness. How can a free society balance those competing demands?*[4]

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2 These countries are Cuba, Libya, Iran, Iraq, North Korea, Sudan, and Syria. Students from countries subject to Non-Proliferation controls (China, India, Israel, Pakistan, and Russia) are subject to scrutiny if they wish to study in these fields.
3 "Conducting Research During the War on Terrorism: Balancing Openness and Security," U.S. House of Representatives, Committee on Science, Hearing Charter, http://www.fas.org/sgp/congress/2002/101002charter.html.
4 "Congressman Sherwood Boehlert (R-NY) Opening Statement for Security Hearing, Oct. 10, 2002, U.S. House of Representatives, Committee on Science Hearing, http://www.fas.org/sgp/congress/2002/101002boehlert.html.

Presidential Science Advisor John Marburger testified at the hearing that the federal government has established an interagency working group comprised of representatives from the Departments of Justice, State, Agriculture, Commerce, Defense, Education, Energy, the National Science Foundation, the National Institutes of Health, the intelligence community, and law enforcement to "find the right balance between scientific openness and national security" in implementing the HSPD-2 Directive.[5] The work of this group has resulted in the establishment of an Interagency Panel on Advanced Science and Security (IPASS) to review visa applications of advanced students and visiting scholars. According to Marburger, "IPASS will assess what uniquely available scientific knowledge is emerging, where it is available, and which terrorist groups or organizations may be trying to gain access to it."[6]

Marburger also testified that the Administration is developing "guidance" regarding the handling, sharing, and disclosure of "sensitive homeland security information."[7] An example of this type of sensitive information surfaced in early 2003 when the U.S. Central Intelligence Agency (CIA) announced it would be "assembling a short, classified summary" of an unclassified meeting of microbiologists who were invited to discuss scientific openness.[8]

Bowing to pressure and the Bush Administration's threat of mandated restrictions on open scientific publication, the editors of some of the most prestigious scientific journals recently took the unprecedented step of adopting a "Statement on Scientific Publication and Security" in which they agreed to screen documents and withhold them from publication if the "potential harm of publication outweighs the potential societal benefits."[9]

The conflict between scientific openness and national security restrictions is now raw, and leading institutions and universities are beginning to address the issue. For example, a faculty committee of the Massachusetts Institute of Technology (MIT) recently recommended that classified research be conducted off-campus and strongly stated in its report that:

> *National security, the health of our nation and the strength of our economy depend heavily on the advancement of science and technology and on the education of*

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5 Statement of The Honorable John H. Marburger, Director, Office of Science and Technology Policy Before the Committee on Science, U.S. House of Representatives, Oct. 10, 2002 at 4, http://www.fas.org/sgp/congress/2002/101002marburger.html.
6 *ibid*.
7 *ibid*.
8 Peg Brickley, "CIA openness report to be classified?" http://www.biomedcentral.com/news/20030407/03.
9 "Statement on Scientific Publication and Security," http://www.fas.org/sgp/news/2003/02/sci021503.html, Feb. 15, 2003 (to be published in *Science*, *Nature*, and the *Proceedings of the National Academy of Sciences).*

future generations. The well-being of our nation will ultimately be damaged if education, science and technology suffer as a result of any practices that indiscriminately discourage or limit the open exchange of ideas.[10]

Georgetown University Law Center, the H.J. Heinz III School of Public Policy and Management, The Century Foundation, and Carnegie Corporation of New York hosted a conference April 24-25, 2003 to discuss the tensions between national security, government accountability, privacy, and civil liberties entitled "Security, Technology, and Privacy: Shaping a 21st Century Public Information Policy."[11]

The Center for Strategic and International Studies and the National Academy of Sciences recently announced that they have agreed to jointly undertake "an evaluation of the relationship between scientific communication and national security in the post-September 11 threat environment."[12] Through a series of projects and meetings over the course of two years, the two institutions will address (1) how to manage the evil use of "sensitive unclassified information" that might lead to terrorists producing and delivering chemical, biological, and nuclear weapons, and (2) how to handle "international peer-to-peer contacts and visits while ensuring a thriving and secure scientific environment."[13] A similar initiative is being held by the Brookings Institution in May 2003 on "National Security and Open Government."[14]

Likewise, scientists are joining the debate through presentations and remarks in scientific fora and through publication. Dr. Gigi Kwik gave an articulate presentation at the February 2003 annual meeting of the American Association for the Advancement of Science, which was subsequently published in *Biodefense Quarterly.* Arguing that the scientific community must work to prevent terrorism, Kwik rejects "'command and control' governance mechanisms, advocating that:

Over time, we must build a network of checks and balances: regulations, incentives, cultural expectations and practices that encourage and enable progress in scientific understanding so that scientific knowledge can address human needs, while

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10 "MIT panel urges off-campus sites for classified research; reaffirms openness on MIT campus," *MIT News*, http://web.mit.edu/newsoffice/nr/2002/publicinterest.html; *see also* Nathan J. Heller, "Sept. 11 Research Limits Draw Fire: Harvard, MIT panelists decry federal rules," Feb. 24, 2003, http://www.thecrimson.com/article.aspx?ref=274170.

11 *See* http://insites.heinz.cmu.edu/securityandprivacy/index.html.

12 "The Collaboration between The Center for Strategic and International Studies and The National Academies on Scientific Communication and National Security," http://www.csis.org/tech/ssi/csis_na.htm.

13 Press Release, "National Security, Scientific Openness: CSIS-National Academies to Develop Plan for Keeping "Sensitive" Information From Terrorists," Mar. 14, 2003, http://www.csis.org/press/pr03_17.htm.

14 *See* http://www.maxwell.syr.edu/campbell/opengov/.

simultaneously assuring responsible stewardship of bioscience so that it is not used for malevolent purposes.[15]

II. Questions for Discussion

The current environment raises several serious, complex questions:

- Can unilateral U.S. controls on student studies and research upset global scientific openness?

- How will national security restrictions on scientific communication impact existing research and the scientists engaged in it?

- With so many diverse methods of publication (such as the Internet), will self-censorship by journals be effective?

- Will self-censorship by journal editors deter scientists from submitting papers on cutting-edge topics?

- Who determines what topics or aspects of research are "sensitive?" One editor? One country? The scientific community? What if information one country/editor perceives as a threat is not viewed as a risk by another country/editor?

- Who determines what students should be excluded from course areas or research? With terrorist cells in over 60 countries, how is an objective determination made?

- With increasing overlaps in scientific disciplines, how can the exclusion of a handful of scientific "areas" effectively deter terrorism?

- Could controls on access to certain "agents" similarly restrict scientific communication and academic research by prohibiting the participation of certain students?

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15 Gigi Kwik, "Biosecurity: Science in the Balance," *Biodefense Quarterly*, Winter 2003 at 3, http://www.hopkins-biodefense.org/pages/news/pdf/quarter4_3.pdf. Christopher Davis, Karl Simpson, Ron Atlas, and John Steinbrunner also presented at the AAAS session, and their remarks are summarized in the Kwik article at 10

- If stricter access to certain scientific information is a legitimate countermeasure to terrorism, does that make it an acceptable practice?

- Is the threat from terrorists that much greater than the threat from rogue nation states which have funded research laboratories, teams of well-trained scientists, established intelligence institutions, and the mechanisms to deliver biological and chemical weapons?

- With stricter immigration controls and network capabilities, scientific collaboration via the Internet becomes an increasingly attractive option, but will national security restrictions unnecessarily restrict these types of programs?

- Is openness always vital? There are many examples of scientific breakthroughs that have occurred in closed environments.

- How does the international right to freedom of expression and the First Amendment stand against arbitrary decisions by editors, scientists, or governments? Can a country exercise extra-territorial jurisdiction to censor or restrict certain scientists from research projects outside of its borders? Could export controls effectively restrict the dissemination of certain scientific materials?

- This is a multi-disciplinary issue involving legal, policy, scientific, academic, and technological expertise. Should other countries assume a larger role in this area?

- What role should be assumed by the international legal and scientific community and policymakers? Should the UN more actively engage in this area?

- How can the Internet be used to foster collaboration on this issue?

- How can scientists use the Internet to promote scientific openness? Through projects? Listserver and discussion groups? Scientific collaboration?

Hopefully, discussions at the December 2003 Trilateral Seminar on Science, Society and the Internet can provide insights into some of these questions and, equally important, stimulate additional discussion and actions by participants and their colleagues in Japan, China and the United States.

E-Commerce and Management Change in China*

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I. Preface

Strengthening E-commerce is a significant part of the information-technology- driven-industrialization strategy of the Chinese government. The Chinese government has adopted the policy of application leading, market inducting, resources sharing, technology innovating and competition opening to establish an holistic strategy and program implementing process for E-commerce development, and has established criteria and legislated for E-commerce. Under the Chinese government's leadership, a China International E-Commerce conference has been hold annually in past six years, and *the research on the method and managerial theory of electronic commerce* was listed by the National Natural Science Foundation of China (NSFC) as the only key program in E-commerce research area during the Tenth Five Year Plan period. Besides, much significant progress in E-commerce growth has been made in the past few years. Especially in 2002, concrete contents and specific progress have been achieved and the volume of business-to-business (BtoB) trade has increased rapidly.

E-commerce is widely impacting economic and social activities, and bringing innovations to the E-commerce participants in many fields today.[1] This paper will discuss the impacts and effects oriented from the management changes, economic growth and social development under E-commerce in China.

II. Change of Enterprise Management on E-commerce

Some new thoughts and technologies of management have succeeded in enterprise, which had been regarded as a information-technique-pull result,[2] while in the growth of E-commerce, these

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[1] Yang De-li. Research on the Method and Managerial Theory of Electronic Commerce. *Journal of Dalian University of Technology, 2000*, 40 (12): S123-S126. (In Chinese)

[2] Wang Zhong-tuo. *Information Technology and Management Transformation*. Dalian: Dalian University of Technology Press, 2000. (In Chinese)

new thoughts have led to many profound changes of management theory and practice oriented from the real operation.

Supply Chain Management and Logistics. Supply Chain Management **(**SCM) should achieve systematized management of agile virtual enterprises (AVE), optimized management of manufacture resources, communized management of uncertain demand information, and agile management of manufacturing.[3] For the systemic implementation of Material Requirement Planning (MRP), Manufacturing Resource Planning (MRPII) and Enterprise Resource Planning (ERP), the SCM among different sections in firms have been achieved. SCM now has evolved to integrated SCM, which would powerfully support BtoB on optimizing the functions of supply chain systems, improving correspondence with other enterprises, and promoting the agility of the whole supply chain. Integrated SCM programs have been developed and the methodology of intelligentized SCM is emerging.

BtoB is the major E-commerce form in China today. So logistic E-commerce has been listed as the key E-commerce project and is progressing rapidly. In early 2002, logistic distribution and E-commerce were adopted by the State Economic & Trade Commission of PRC as foci of transportation industry modernization in the near future. With the development of logistic E-commerce, optimized logistics systems would drive SCM greatly.

Organizational Change and Business Process Reengineering (BPR). Under E-commerce, virtual corporate, enterprises union, networked organizations etc. would emerge on the information network. These have been regarded as the main instrumentality for enterprises to run E-commerce.[4]

Under these circumstances, the pyramid structure of traditional organizations were challenged and transformed into flat network structures. Accordingly, centralized authorizations were replaced, and networked organizational structure could extend outside of enterprise. So BPR could possibly be accomplished, which would be the chief methodology of electronic business management.

However, there are no basic BPR paradigms for firms in different industries and trade. BPR tactics should accommodate competition strategy, business characteristics, and specific information

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[3] Saad, Mohammed; Jones, Martyn; James, Peter. A Review of the Progress towards the Adoption of Supply Chain Management (SCM) Relationships in Construction. *European Journal of Purchasing and Supply Management, 2002*, 8 (3): 173-183

[4] William H. Davidow, Michael S. Malone. *The Virtual Corporation: Structuring and Revitalizing the Corporation for the 21st Century*. New York: Harper Collins Publisher, 1992

technology (IT) implementation. It is perfect theoretically to integrate BPR with ERP, whereas, system failure also cannot be neglected because of the issues from enterprise culture, employee cultivation etc.

Changes in Enterprise Managerial Functions. In E-commerce, traditional enterprise management theories and methodologies have been challenged greatly and have changed actively.

Changes in Management Theory Essentials. Generally, the essentials of classical management theory consist of planning, organizing, leading and controlling.[5] In E-commerce, the above characteristics have varied somewhat.

Above all, enterprise planning strategy would put much more emphasis on core competence than ever before rather than on traditional extensively planning. The methodology of planning would center SCM and BPR. The traditional organizing structure has been transformed from a pyramid into a flat network which can extend out of enterprise; and centralized authorization has been replaced by dispersive authorization.

Additionally, theories and technologies of decision making and control have been innovated a good deal. Decision Support Systems (DSS), Management Support Systems (MSS), Executive Support Systems (ESS), Expert Systems (ES) and so on should have great application potential under E-commerce. Controlling tends to be exact accuracy. Manufacture technologies, such as Computer Integrated Manufacturing (CIM), Just-in-time (JIT), Lean-Agile-Flexible (LAF) and Total Quality Control (TQC) would be the dominant technologies in E-commerce.

The methodology of leading would be modified accordingly. The method of seasoning with the enterprise culture of velocity, innovation, team spirit, team learning, virtualization, assimilation etc. should be further discussed.[6]

Changes in Management Functions. The principal functions of management in enterprise fulfillment always include marketing, producing, research and development (R&D), accounting and financing, human resource management.

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[5] Stephen P. Robbins, David A. De Cenzo. *Fundamental of Management* (2nd Ed.). Prentice-Hall, Inc. 1998
[6] Yao Guo-zhang. *Electronic Commerce and Enterprise Management*. Beijing: Beijing University Press, 2002. (In Chinese)

Above all, there has been a primary impact on traditional marketing. The Internet provides an unmatched facility to distribute information for merchandises and services. Combinatorial selling, market subdividing, and so on have been innovated, as Custom Relationship Management (CRM) which has been widely adopted and has developed as one of crucial conceptions of enterprise management.[7]

Second, lots of new producing patterns have emerged such as Computer Assisted Design (CAD), Computer Assisted Manufacturing (CAM) and Computer Integrated Manufacturing Systems (CIMS). So has producing with low inventory or JIT, manufacturing with the assistance of MRP/MRPII/ERP and by means of man-machine interaction systems, all these innovations have upgraded the traditional production pattern. In E-commerce, production patterns have evolved to mass customization to meet a single customer's need.

Third, E-commerce has transformed the form of technology-trade, widened the view of enterprise R&D, and affected the management of extraneous technologies. The organizational structure of technology R&D and its management are being subject to significant innovation.[8]

Additionally, accounting and financial data can be processed by networking and can be transmitted via the Intranet/ Extranet/ Internet. A job can be accomplished by cooperating in virtual space thus realizing efficiently centralized corporate financial management and timely control. Since the conception of corporate management has been profoundly changed, accounting measurement, accounting object, theory hypothesis and control will also need to be amended.[9] Meanwhile, changed corporate management concepts provide possibilities for timing accounting management and reporting.

In Human Resource Management (HRM), applications solicitation, information management and evaluation can all be carried out on the network. Meanwhile, discussions are underway on how to reeducate, motivate and supervise employees in E-commerce. With the application of knowledge management, HRM theory and technology would be regenerated in learning organization under E-commerce.

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[7] Chi Guo-tai, Li Ming-ling and Yang De-li. Strategy of Customer Relationship Management in Electronic Commerce Environment. *China Soft Science, 2002*, 17(7): 52-56 (In Chinese).
[8] Huo Yun-fu, Chen Xin-yue, Yang De-li and Dong Yi-zhe. Study on Enterprise Innovation Network. *Science of Science and Management of S&T, 2002*, 23(10): 33-36 (In Chinese)
[9] Li Duan-sheng and Li Zheng. The Tendency of Accounting Development in Network Economy. *Accounting Research, 2001*, (11): 55-58. (In Chinese)

Technologies in Management Transformation and ERP. Changes in management theory and technology are being achieved with the support of IT. The impacts of E-commerce and the utilization of information technique in E-commerce will also influence the direction of management innovation.

Information processing in enterprise management proceeds via the following stages: Electronic Data Interaction (EDI), Management Information Systems (MIS), DSS, ESS and ES.[10] It has evolved to artificial intelligent decision making. Computer and IT assisted management, also proceeds via several stages: Transaction Processing Systems (TPS), Office Automation (OA), and Computer Systems for Collaboration Work (CSCW) such as MRP, MRPII, ERP, and e-ERP.

China Computer World (CCW) Research reported that in 2002, ERP software accounted for a 54.5 percent share of management software market in China, and the sale of ERP had reached 1.5 billion Yuan. This was an increase of 64.7 percent of that of 2001. Sales of EPR software in China in 2002 exceeded the sale accounting and financial management software for the first time. This indicates that more enterprises have made a point of programming ERP systems than ever before. On the other hand, many factors such as BPR, software development, implement technology, facilities sustaining, and enterprise culture could lead to the failure of ERP. How to accomplish ERP operation is a challenge for enterprise management. Moreover, in E-commerce, issues emerging include how to integrate ERP with SCM, CRM, DSS,[11] and to realize e-ERP.[12]

The changes of management theories and technologies on aspects highlight above can be described in three dimensions: theory essentials, management functions, and the information application stage as in Fig.1.

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[10] Yao Wei-li and Yang De-li. Information Technology and Management Innovation. *Science Research Management, 1998*, 19 (3): 55-60. (In Chinese)
[11] Yang Deli and Wang Qian. The Development of ERP and Integration of E-commerce and ERP. *China Soft Science, 2002*, 17(4): 111-114, (In Chinese).
[12] Ash, C G and Bum, J M. A Strategy Framework for the Management of ERP-enabled E-Business Change. *European Journal of Operation, 2003*, 146 (2): 374-387

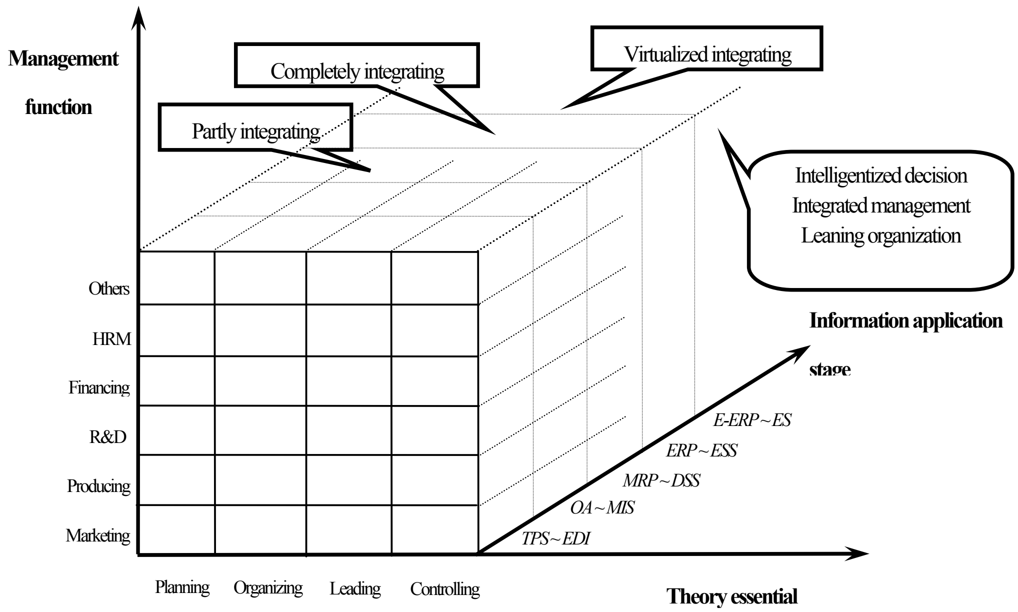

Figure 1

We conclude that enterprise management transformation is leading to intelligentized decision making, integrated management, and learning organization.

Learning Organization. The concept of a learning organization emphasizes an organization's ability to learn. It involves the conversion of thoughts, systematical conceptions, and the agreements on perspective.[13] Theories of learning organization based on knowledge management have been developed for use in real operation.

Many software firms now have energetically developed the knowledge management solutions for corporate, government, and some specific trades. Knowledge management should be supported by IT and artificial intelligence (AI). But its operation can also be hindered by the factors such as organizational culture, employee management, manner of decision making, and operational processes.[14] An emerging issue is how to integrate knowledge management systems with the other management systems.

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[13] Senge, P M. *The Fifth Discipline*. Doubleday Dell, 1990

[14] Desouza, K C. Knowledge Management Barriers: Why the Technology Imperative Seldom Works. *Business Horizons, 2003*, 46 (1): 25-29

III. E-commerce and Network Finance

The Chinese government has paid considerable attention to network finance development. The People's Bank of China (PBC) and the state owned commercial banks have constituted special institutions to construct network finance systems for E-commerce development.

Electronic Payment Systems. Electronic payment is the pivotal process in E-commerce. Payment gateway and certificate authority are the essential parts of electronic payment systems.

Payment Gateway Construction. Cooperating with commercial banks, branches of PBC have generally deployed a payment gateway on the bankcard information exchange network among commercial banks in central cities. The major components of the PBC scheme are to popularize the experimental projects of electronic payment systems and to accomplish the '314' program of bankcards on the network by the end of 2003 are the major parts of PBC scheme. This scheme would provide the necessary facilities for electronic payment systems in E-commerce.

Construction of CA and RA. Initiated by 14 commercial banks and constructed by the bankcard information exchange centre of PBC, China Finance Certificate Authority (CFCA) acquired the National Security Qualification on Certificate Systems of Information Security in August, 2002. The business of CFCA has extended from banking to stock jobbing, communication, taxation, insurance agent, and corporate groups, and has played the foundational role in network finance. CFCA has established certificate applying and approving systems in 12 countrywide commercial banks and 16 stockjobbers. The value of network financing on CFCA's certificate has surpassed trillion Yuan. Moreover, CFCA is promoting universal certificates to predominate the unified financing certificate, which is the basis of network payment among different banks.

There are 12 banks which have built RA as a pilot test of CFCA's certificates. Additionally, Dalian, Shenzhen and Xiamen have been authorized by CFCA to constitute through the local bankcard centers RA to assess local certificate applicants. Many other financial institutions, offices and large enterprises intend to employ CFCA's certificate.

Net Bank. China Internet Network Information Center (CNNIC) statistics shows that the number of Internet users in China had reached 78 million by the end of 2003, the second largest in the world. Chinese commercial banks and some foreign banks which have been permitted to engage in domestic finance have commenced to develop net bank services energetically. Collaborating with eight head commercial banks, China Unicom has constructed China Unicom E-commerce platform of BtoB and business-to-customer (BtoC) to provide trans-regional services across the country. It is obvious that the growth of net banking will bring the financial industry into heightened competition.

At the present, there are diverse technological standards among different banks; unifying these standards awaits a proper solutions. Developing enough self-owned intellectual poverty technology for net banking and financial products is also a crucial issue for Chinese banks to permit them to compete with foreign banks.

Network Financial Service. A statistic of China Securities Regulatory Commission (CSRC) reported that, in 2002, the quantity of stocks exchanged on the network was 8.99 percent of the total exchange volume of the Shanghai and Shenzhen Stock Exchanges, and clients of commission exchange was 14.78 percent of the population of clients who opened accounts on Shanghai and Shenzhen Exchanges. At the end of February, 2003, 89 stockjobbers had been qualified by CSRC to engage in network stock exchange, which means that they constitute 72 percent of the 124 stockjobbers in China. In E-commerce, security, insurance and other financial institutions have created positions such as Internet stockjobber, Internet insurance agent and so on, which has innovated their services and reconstructed their capital turnover and will also provide opportunities for innovations of financial derivate products.

Management and Supervision of Network Finance. In E-commerce, distinctions among different kinds of money would disappear, thus influencing the accuracy of money measurement. Regarding money supply, electronic money issuers could not be limited, which would reduce the role of the central bank as the only money issuer. These factors would impact the central bank capacity to modulate gross financial assets size.[15] Many issues concerning the impact of electronic money systems on the traditional money supply and money policy functions need to be discussed.[16,17]

The capital turnover would become more independent from material distribution in E-commerce. So financial risk management, the methodology of financial products creation, the evolution of market systems, and even the financial crisis in network finance would inevitably be the further issues.

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[15] Dai Xiang-long. The Speech on Network Economy and Governance. http://www.pbc.gov.cn， 23, Apr, 2001
[16] Xie Ping and Yin Long. The Financial Theory and Financial Governance under Internet Economy. *Economy Research Journal, 2001*, (4):24-31 (In Chinese)
[17] Yin Long. Restudy of Monetary Nature and the Development Monetary Theory. *Journal of Financial Research, 2002*,

IV. E-commerce and the Government

The Chinese government has created institutions for improving E-commerce, such as the China International E-commerce Centre in 1996, the China Electronic Data Exchange Technology Commission in 1997 at the outset of Chinese E-commerce, and the China E-commerce Association authorized by State Department in 2000. The latter organization has facilitated the acceleration of E-commerce in China recent years. Additionally, the State Department has authorized Shanghai, Shenzhen and Dalian as demonstration cities of E-commerce implementation. Provincial governments are also supporting some local E-commerce demonstration projects, resulting in successful experiences for operating E-commerce and providing basic facilities for the further expansion of E-commerce.

Fundamental Establishment. In China, based on "golden projects", E-commerce began by providing services for foreign trade and management and grew rapidly on the nation communal telecom network. The Chinese government has sponsored a series of "golden projects" such as golden bridge project, golden cards project, golden custom project, and golden taxation projects. These have laid the groundwork for the further expansion of E-commerce. In particular, the actions of CFCA could not have been superseded in China today.

Information Industry Policy. The Chinese government had indicated that the crucial strategy of modernization during Tenth Five Year period is to propel the nation's economy and social informatization energetically. For this reason, the government is devoting unprecedented emphasis to developing E-commerce. Major programs adopted by the Chinese governments in the area of E-commerce are: to improve the construction of information fundamental facilities and Internet applications, to promote informatization of large enterprises and networks of firms, and to sustain E-commerce applications in some significant industries, such as foreign trade, banking, telecommunications, post, aviation, medicine, logistic and manufacturing.

In July 2002, the National Informatization Leading Group passed *the specialized program on national economy and society informatization* and *the guidance on China electronic government construction*. These documents emphasized aspects to be furthered under government guidance: developing information resources, constructing fundamental facilities, and applying IT and information product. These aspects should be furthered by means of the market economy and social potency. The E-commerce legislation, the national IT standards systems, professional

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23(1):55-62 (In Chinese)

cultivation and knowledge popularization are also emphasized in these policies. All these policies and strategies had affected China's E-commerce progress profoundly.

Government-to-Business. *The PRC Government Purchase Law* was legislated by the People's Congress Commission of PRC in June 2002 and began to be implemented on January 1, 2003. From then on, "sunning purchase" is the law, which is the foundation for the governments purchasing and inviting biding government-to-business (GtoB) transactions.

Electronic taxation began with the golden taxation project. The State Administration of Taxation authorized Digital China, Inc. to design and actualize China Taxation Administration Information Systems (CTAIS) in the countrywide, which was the beginning of electronic taxation administration in China. Declaring dutiable goods systems have now have been introduced, for instance, the taxation net of Dalian E&T Development Zone has been employed in taxation administration.

Additionally, some other GtoB transactions are carried out via the net, such as industry and commerce administration, information counseling, and small business service[18].

Electronic Government. Developing electronic government is one of the primary tasks of the China Ministry of Information Industry. The government statistical data shows that the quantity of government websites now exceeds 10, 000. The government-on-Internet project has promoted the Chinese government informatization significantly.

In electronic government, traditional bureaucratized institutions should be modified to promote the flexibility and efficiency of information processing and in responding. It is essential for electronic government that departmental information obstruction be broken down, and systems for vertical and horizontal intercommunication be developed. The directions of electronic government development are seamless, integral, agency-specific, participatory, and enterprise-like-knowledge management being the guiding model.[19]

Virtual markets on E-commerce also need rational government intervention. So another urgent mission in E-government construction is how to upgrade administrative capabilities on integrated

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[18] Research Centre of State Department. The Development and Institution Construction of Electronic Government in China. *Journal of Comparative Economic and Social Institutions, 2002*, (3):92-99 (In Chinese).
[19] Chen Bo and Wang Huan-chen. E-government and Government Paradigm. *Journal of National Administration College, 2002*, (4): 23-25. (In Chinese).

comprehensive administrative information systems and intelligent decision support systems. Efficient rational decision support systems also rely on the reformation of governmental administration. A mature reformation mode is being developed and the interaction between E-commerce and electronic government will truly propel this reformation.

V. Legislation on E-commerce in China

The development of E-commerce also calls for relevant legal systems. Now, the construction of E-commerce law is an international issue.

In China, *PRC Electronic Signature Ordinance (draft)*, *Internet Publication Administration Provisional Regulation* and *Electronic Commerce Supervision and Administration Provisional Regulation* came into force during July and August 2002, respectively. These ordinances covered mostly aspects of electronic business, in conjunction with *Contract Law (1999)* and other concerned E-commerce regulations and regional legislation. E-commerce law systems are nearing completion in China. In addition, provincial people's congresses are actively drafting relevant regulations. For example, the *Guangdong Province Electronic Exchange Ordinance* has been passed and has gone into effect; *Shenzhen Electronic Commerce Regulation (draft)* has been submitted to all departments concerned. A long-term issue for provincial governments is how to harmonize specific local conditions with international conventions.

VI. Security in E-commerce

Security problems in data transmission over the Internet imperil the progress of E-commerce. Business risks, money market risks and problems in electronic government more or less come from the security issue.

E-commerce grows on the highly esoteric Internet. On the other hand, esoteric network collides with the business requirement of secrecy. Therefore, information security technologies (encryptation technology, firewall, key management, cryptography, authentication, information hidden technology information countermeasure), standards of IT security, security control systems for information system and technologies, safety defense systems and information security infrastructure are all bottle-necked issues[20] in E-commerce growth and urgently to be advanced.[20]

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[20] Marilyn Greenstein and Todd M. Feinman. *Electronic Commerce: Security, Risk Management and Control*. McGraw-Hill, 2000.

Information and network safety defense involve a complex dynamic. They must rely on the harmonized development of legislation, management mechanisms, and technologies consistent with the growth of E-commerce. Moreover, only when the safety defense system and its strategies can be checked and evaluated continually, can perfect security systems be possibly established.

VII. Educational Developments under E-commerce

The lack of persons with ability is a big obstacle for the progress of E-commerce.

Tele-education and Internet education have grown swiftly. China's Ministry of Education expanded its tele-education experiment from 45 to 67 colleges and universities in 2002. Tsinghua, Peking, and Fudan Universities have all developed tele-education and Internet education. Internet education and tele-education are transforming traditional modes of education manner are growing to emerging as a new education industry. Appropriate patterns and management form for Internet education is now being explored.

China's Ministry of Labor and Social Security has instituted *Nation Criterion on Electronic Commerce Professional* and *Technology Scheme of Electronic Commerce Professional Uniform Qualification*. In August, 2002, the first E-commerce professional examination is took place in Jiangxi Province. The Ministry is expanding the examination and qualification procedures to the countryside—for example, in an experimental pilot project in Nanchang.

As to the urgent need for more professionals, there is viewpoint that E-commerce should be constructed as a specialty subject. The subject systems should consist of the theory of E-commerce systems (composed of fundamental, development research, regulation research, education research, economic issues, social issues, and relative fields), and the E-commerce technology system (composed of establishment layouts, technology of systems engineering, website construction and management, logistics, Internet marketing, security, enterprise management and custom management).[21] Professional education and courses on E-commerce have been discussed heatedly. The problem of how to unite foreign colleges and universities to assimilate appropriate experiences is also in deliberation.

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[21] Jin Zhen. On Electronic Commerce Science Systems. *Journal of Shenyang University, 2002*, 14(2):17-19 (In Chinese)

VIII. Concluding Remarks

Global competition in E-commerce can be understood in terms of competition among different countries of management technology transformation and the environment for the construction of E-commerce. In global E-commerce, innovations in management theory and technology will not be confined to the areas of business firms, money market and government. They will also impact many fields of society such as culture and education. Meanwhile, legislation and security systems should correspond to the E-commerce evolution dynamically. The innovations of management theory and technology resulting from the development E-commerce have tended to be an immense social engineering system.