

# **INTEGRATING HIGH QUALITY DIGITAL SCIENCE POPULARIZATION RESOURCES IN THE SOCIETY TO ESTABLISH THE SHARED PLATFORM OF NATIONAL SCIENCE POPULARIZATION RESOURCES – THE SCIENCE AND TECHNOLOGY MUSEUM OF CHINA**

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## **ABSTRACT**

*The project of the Digital Science & Technology Museum of China is constructed by the China Association for Science and Technology, Ministry of Education and Chinese Academy of Sciences, of which the objective is to integrate the high quality digital science popularization resources in China to construct an Internet-based national science popularization resources sharing platform. This project complies with the objective requirement of Internet-based science popularization in China that has groundbreaking significance. The construction at Stage I includes the construction of Museum A (museum), Museum B (experiencing museum), Museum C (resources museum), and an information service platform. During construction the project has been faced with many problems, such as how to integrate numerous science popularization resources for sharing and how to realize the function of science experiencing of the digital science & technology museum to attract the public. These problems will be explored and resolved in practice. The units participated in this project will, by combining the requirement for science popularization at the grass roots level, aggressively launch the application and extended service of this project.*

**Keywords:** Internet-based science popularization, Digital Science & Technology Museum, Resource sharing, Platform construction

## **1 PROJECT BACKGROUND**

In December, 2005, the project of the Digital Science & Technology Museum of China was approved and started. The Digital Science & Technology Museum of China is one of the 43 sub-projects of 6 platforms of the required construction projects for national science and technology. It is the only project dedicated to public science and technology education for the whole society. The construction of the Digital Science & Technology Museum of China is funded by national finance, the China Association for Science and Technology, the Ministry of Education, and the Chinese Academy of Sciences. The objective is to integrate national high-quality digital science resources to construct an Internet-based national science resources-sharing platform.

China has attached great importance to the popularization of science and improvement of its citizens' scientific knowledge to boost the overall development of the economy, society, and population and to lay down a foundation of human resources for upgrading independent innovation ability and comprehensive national power, constructing an affluent society, and achieving the strategic objective at the third step of the modernization drive.

On July 3rd, 2004, the General Office of State Council forwarded "The National Program for Sci-Tech Basic Conditions Platform Construction during the Year of 2004-2010" of the Ministry of Science and Technology, the National Development and Reform Commission, the Ministry of Education, and the Ministry of Finance and announced that the construction of the foundation of national science and technology was started.

In January 2006, in his address to the National Science Conference, President Hu Jintao set forth the program "to strengthen the construction of basic foundations platform of science and technology and to reinforce the guidance and coordination on the establishment of significant technical standards."

In February 2006, part nine of the "National Long- and Medium-term Program of Sci-Tech Development Planning" regarding "science and technology input and basic conditions platform of science and technology" presented a description of the basic foundations platform of science and technology: "supported by the technology of information and network, etc, it consists of research and experimental bases, large-scale scientific facilities and instruments, scientific data and information, and natural science and technology resources, which are a support system serving for technological innovation of whole society through effective configuration and sharing."

On February 6, 2006, the State Council issued the "Program of National Scientific Quality Action Plan (2006-2010-2020)" that established an objective that will greatly improve the education, promotion and popularization of science and technology and the quality of national science.

On September 14th, 2006, the National Scientific Quality Office issued a notification regarding forwarding of the "Executive Plan of Resource Exploitation of Science Popularization and Sharing Project" (Quan, Ke, Zhu, Ban, & Fa, 2006), which clearly sets forth "by taking the Digital Science and Technology Museum of China as priority, to construct information resources sharing and a communication platform for science popularization and to explore effective modes for the product resources of science popularization for serving the public."

## **2 SIGNIFICANCE OF THE PROJECT CONSTRUCTION**

### **(I) It complies with the objective requirement of Internet-based science popularization in China**

Along with social development, more and more information resources, especially resources regarding public interest and scientific education, are accessible to the public internationally on the Internet. Integrating, processing, and converting the existing public scientific and technical information resources into information for science popularization that can be understood by the masses and can be used by public science educators and shared via Internet is becoming an international development trend. Entertainment and interactive science popularization information is popular with the public and has significant long term potential. Taking a broad view of the development trend of Internet-based science popularization in some developed countries, the mixture of on-line scientific experiments, detailed explanations or scientific cartoons, and even games have

replaced the traditional pattern of spreading information of science popularization websites that was welcomed by cyber-citizens. We should take advantage of new developments of this era by using the features of modern networks as a new type of media and utilizing the technologies of online games, virtual museums, virtual interactive exhibitions, and virtual scientific experiment visualization to develop an Internet-based science popularization form which will be appreciated by the public.

The Union of Internet-based Science Popularization under the Internet Society of China performed an "Inquiry and Study of the Present Internet-based Science Popularization in China" in 2005. Based on the data collected, analyzed, and studied for 408 websites and columns of science popularization, it raised several issues concerning the present Internet-based science popularization in China:

**1. Monotonous Manifestation.** At present, the manifestation of science popularization websites and columns in China is monotonous, with a lack of entertainment quality and interaction. The contents of these websites are mainly text and pictures, and they ignore the more vivid and interesting multimedia manifestations such as audio, video, and games.

**Table 1.** The Manifestation of Websites and Columns of Science Popularization in China

Manifestation	Ratio (%)
Graphics files	83.6
Effective audio, video, Flash and other multimedia documents	29.5
Other forms, by which knowledge can be attained and games can be participated in interactively through programs or other technical supports	19.8

**2. Shortage of information content and inconvenient retrieval.** There are no mature websites of Internet-based science popularization in China at present, and the available websites are inconvenient for public retrieval. Public science educators are frequently discouraged when searching for materials for creating works or developing products of science popularization.

**Table 2.** Indices Table of Websites Readability of Science Popularization

Readability indices	Ratio (%)
Websites that can be retrieved by multiple-approaches such as assortment, theme and keyword	27.9
Websites that provide help information such as instruction, introduction, and website map	16.4
Websites from which information can be printed or downloaded	83.6

**3. Joint construction and sharing mechanisms have not yet been formed.** Having been in development for over 10 years, the number of websites and columns of science popularization in China is considerable, but most of them have little influence and have insufficient information with repetitious content, having failed to realize the joint construction and mechanism for sharing resources.

It can be seen that it is necessary to integrate the existing digital science popularization resources in China by unified planning and sharing service and to exert an even greater effort for Internet-based science popularization

to serve the society more widely and efficiently. The construction of the Digital Science & Technology Museum of China complies with the objective requirement of Internet-based science popularization and provides resolution for the issues mentioned above.

**(II) The construction of the Digital Science & Technology Museum of China has groundbreaking significance**

The Digital Science & Technology Museum of China is an achievement of comprehensive cooperation by scientific, technological, and educational circles in the field of Internet-based science popularization, which for the first time have centralized different advantages of science popularization of the China Association for Science and Technology, the scientific education of the Ministry of Education, and the scientific research of the Chinese Academy of Sciences. The construction of the Digital Science & Technology Museum of China will have groundbreaking significance. It will give full play to the social benefits of scientific and technical information sharing of existing scientific and technical information resources. It will allow the public to acquire authoritative, reliable and large amounts of scientific and technical information. It will provide a convenient and highly-efficient resource service for the creation and development of science popularization works and products and boost science popularization. It will develop scientific and vigorous Internet-based science popularization forms and content, which reflect the advantage of modern network techniques. And it will enhance the position of digital science popularization in China in the corresponding international fields.

**1. It meets the requirement of the vast mass, especially adolescents, to surf Internet.** The cyber-citizens in China has reached 100 million, and the Internet has become an important media influence on social life. The cyber-citizens in China mainly are adolescents who are the important target group of science popularization in China. The existing Internet-based science popularization, however, has failed to satisfy the requirement of the masses, especially the adolescents, no matter the information content or the manifestation. The entertainment on the Internet to which adolescents are addicted is full of pornography, violence, pseudoscience, and other harmful contents; instead of these, what we need is healthy and interesting Internet-based science popularization.

**2. It meets the requirements of science popularization institutions and science and technology workers.** The popularization of science in China has been troubled for a long time by insufficient information resources. It has been difficult for developers and institutions to acquire required materials, resulting in insufficient and low quality product creation and poor development for science popularization. The works and products for science popularization already developed and produced by science popularization institutions have failed to form attractive resources and failed to reach society. The value of these science popularization resources is far from being fully achieved. The exhibitions and propaganda material of science popularization locations and facilities are stale and minimal.

**3. It meets the requirement of the construction of a science and technology museum.** According to an investigation by the Chinese Association of Natural Science Museum in 2004, among 260 or so museums in China's mainland, only 50 have permanent exhibitions and only 30 meet the construction standards of a science and technology museum. Looking at the ratio between the quantity of science and technology museums and gross population, Mainland China is equivalent to 1/12 of America, 1/9 of Britain, 1/24 of Japan, and 1/20 of Taiwan; concerning the ratio of visitors of science and technology museums to gross population, Mainland China is equivalent to 1/33 of America, 1/11 of Britain, and 1/25 of Japan and Taiwan respectively.

**Table 3.** Reference table of the quantity of science and technology museums and visitors of America, Britain, Japan, Taiwan, and Mainland China

Country (region)	Museums in total	Quantity of museum: gross population	Annual visitors	Visitors: gross population	Average visitors per museum
America	560	1:410,000	150 million	About 1:1.5	About 268,000
Britain	80	1:750,000	13 million	About 1:4.6	About 162,500
Japan	550	1:220,000	65 million	About 1:2	About 118,200
Taiwan	90	1:260,000	12 million	About 1:2	About 133,300
China mainland	250	1:5,200,000	26 million	About 1:50	About 104,000

To construct a science and technology museum on a large scale and level requires ten of millions or even hundreds of millions of RMB. However, the economic development of China has restricted the money available for this type of construction. The quantity of visitors to a Digital Science & Technology Museum of China, however, may be ten or even hundred times greater than those of a physical science and technology museum. Visitors to a digital science and technology museum will bring a much greater investment return.

### **3 PROJECT OBJECTIVE AND CONSTRUCTION CONTENT**

The construction of the Digital Science & Technology Museum of China will take three years. When finished, it will establish an information service platform and database; integrate science popularization products and information resources needed to launch an Internet-based science popularization and sharing platform, and digitalize the available social science popularization resources, thus enabling the public, especially adolescents, to increase their ability to master and command scientific knowledge and the scientific method on the virtual environment of the Internet. It will also satisfy the requirements of the developers and creators of science popularization works at the grass root level to share science popularization resource information; and improve the national scientific and cultural quality.

The project of the Digital Science & Technology Museum of China will follow the principle of "overall planning, comprehensive integration; requirement-oriented, service for society; joint construction and sharing; and construction step-wise." Stage I construction includes Museum A (Museum), Museum B (experiencing museum), Museum C (resources museum), and an information service platform construction.

#### **(1) 30 Virtual Theme Museums**

Museum A of the Digital Science & Technology Museum of China is being constructed to give the public, especially adolescents, a display platform for the popularization of science. Thirty virtual theme museums are being constructed for public online study by integrating the available science and technology museums and digital resources for science popularization. By taking a subject field as the background and digital exhibition as a base, the virtual museum introduces the history of the development of science and technology and spreads professional scientific knowledge to the public.

This year, 8 museums have been activated: earth history, earth resources, architecture, aviation, information technology, energy sources, animals, and plants.



Figures 1. and 2. The virtual museum has adopted a virtual floor structure. Dynamic hinge action can be made by pointing to each floor with a mouse to show what it contains.



Figure 3. Museum of earth history

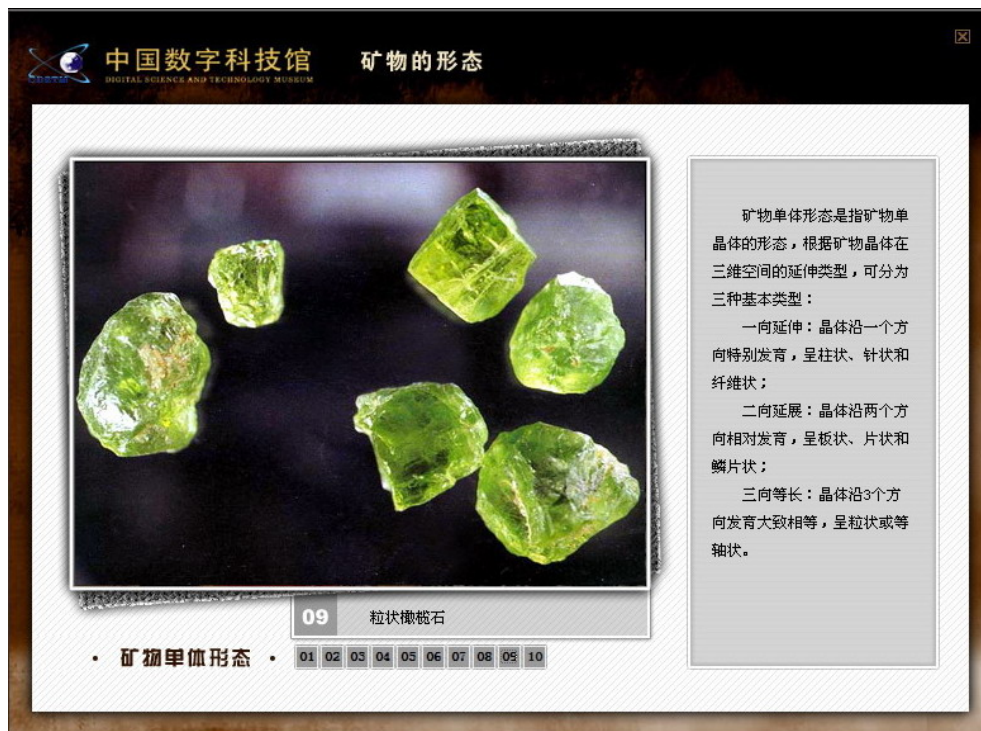


Figure 4. Introducing the shape of minerals

## (II) 20 Internet Science Popularization “Columns”

The main functions of the Internet science popularization “columns” are to pass dynamic information at the leading edge of the development of science and technology; to deeply analyze the scientific meaning behind

science and technology events and their influence and significance on people's lives; and to facilitate the public's understanding of the strategy of the development of science and technology, the decisions made concerning science and technology, and significant engineering developments in China.

This year, six Internet science popularization columns have been activated: the lunar survey project, methods to subdue plague, the human and ecological environment, travel through Qinghai-Tibet, scientific expeditions, and water resources.



Figures 5. and 6. The Internet science popularization column has adopted an airflow design and honeycomb background that can reflect the diversity and precision of science and technology.



### (III) 40 Internet-based Interactive Science Experiencing Museums

Museum B of the Digital Science & Technology Museum of China has been constructed to provide the public, especially adolescents, with a digital virtual scientific paradise. By fully using the interactive nature of Internet media and comprehensive utilization of modern science and technology methods and approaches, such as virtual reality and remote control, forty scientific areas with abundant scientific meaning, multiple experiencing patterns, and a structure of observation and experience, exploration paradise, experiment, and scientific exploration, have been constructed, which enable the public to be able to master and command scientific knowledge and the scientific method onto the virtual environment of the Internet.

This year, ten interactive scientific experiencing museums have been constructed: a public observatory, an ecology survey, a micro world, an open classroom of the forest, exploration on the giant panda, explanation of Mars, music life, a digital human body, ancient machinery, and computer assembly



Figure 7. Gold stands for the light of science and technology, and the bulge in the center displays the interactivity that provides a virtual experience.



Figure 8. Each experiencing area of experience can be clicked on.



Figure 9. The scientific experiencing museum of exploration on the giant panda

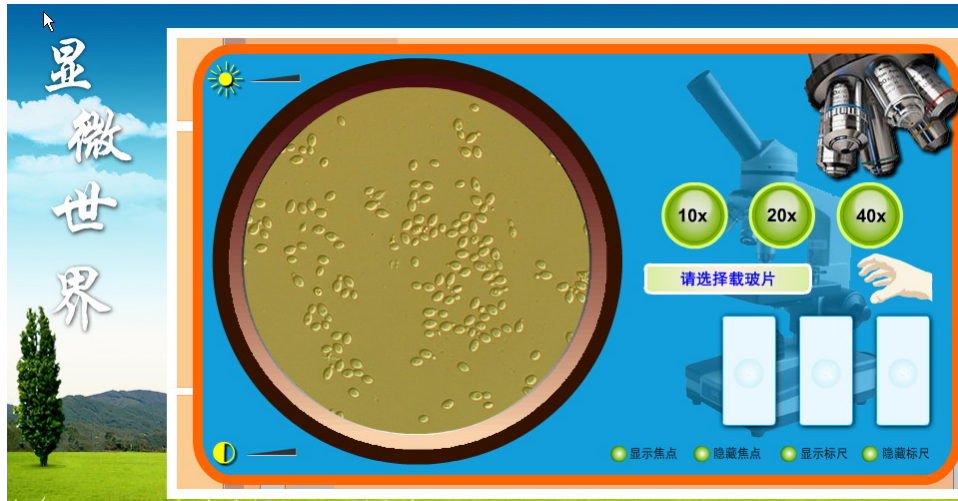


Figure 10. Micro world museum: an observation experiment

#### (IV) Constructing a science popularization resource pool of nine categories

To offer society a resource information service and communication platform for science popularization organization at the grass root level, Museum C of the Digital Science & Technology Museum of China has been constructed. It integrates the available science popularization works and information resources of society together to form a resource database of science popularization with nine categories: a gallery of science popularization, a theme exhibition library of science popularization, a cartoon library of science popularization, an audio and video library of science popularization, a library of science popularization reports, a library of science popularization research data, a library of science popularization educational resources, a library of the exhibitions of the science and technology museum, and a library of the collections of the science and technology museum. It provides a service that shares science popularization resource information for developers and creators at a grass roots level at different levels, forms, and degrees. Nine categories of resource databases of science popularization have been activated this year.



Figure 11. Book format reflecting the nine categories of science popularization resource databases



Figure 12. Gallery of science popularization: Eating for health



Figure 13. Library of science popularization exhibition: agriculture exhibition

**(V) Constructing an information-sharing platform of the Digital Science & Technology Museum of China, to lead the national digital information construction of science popularization**

The project at this stage will develop the information-sharing platform of the Digital Science & Technology Museum of China to realize the integration of applications and data between systems. The research and development of the platform has laid down a solid technical foundation for long-term construction of the Digital Science & Technology Museum of China.



Figure 14. Welcoming page of the Digital Science & Technology Museum of China

The welcoming page of the Digital Science & Technology Museum of China uses Flash, which gives profound meaning in exploring the universe, observing the vicissitudes of the world, and sprinkling the gold light of science and technology, while the black background indicates the mystery of digital technology.



Figure 15. Homepage of the Digital Science & Technology Museum of China

The color of blue dominates the full page that accentuates the authority of the website of the Digital Science & Technology Museum of China. The theme icon in the central display area brightens as the mouse stops and each virtual museum, experiencing museum, and resources museum can be entered.

#### (VI) Establishment of standard specifications for the project

Ten basic standards have been set up according to the requirements for construction and service of the project.

**Table 4.** Standard specifications for the Digital Science & Technology Museum of China

Standard category	Standard	Unit
Guiding standard	1. Standard framework and standard working directions	Computer Network Information Center of Chinese Academy of Sciences (CNIC)
Code for data resources construction	2. Code for Museum (A) Construction	Beihang University
	3. Code for Museum (B) Construction	Computer Network Information Center of Chinese Academy of Sciences (CNIC)
	4. Code for Museum (C) Construction	Computer Network Information Center of Chinese Academy of Sciences (CNIC)
	5. Code for digital acquisition and process of science popularization resources	China University of Geosciences
	6. Metadata standard	Computer Network Information Center of Chinese Academy of Sciences (CNIC)
	7. Code for unique identification of science popularization resources	Computer Network Information Center of Chinese Academy of Sciences (CNIC)
Code for integration service	8. Code for Web Service	Nanjing University
	9. Code for platform management and operation service	China Association for Science and Technology
Code for project management	10. Evaluation mechanism and index system for performance of services	Computer Network Information Center of Chinese Academy of Sciences (CNIC)

Upon the commencement of the project, the units that participated attached great importance to intellectual property protection of resources and, in accordance with related national laws and regulations and related administrative provisions of relevant departments as well as the experience of project construction, drew up a "Method for Authorized Utilization of the Copyright of Science Popularization Resources of Digital Science & Technology Museum of China (Trial)" and required all the participating units to implement it.

**(VII) Developing and researching the critical technology and utility of an Internet-based science popularization**

The technical approach for construction of the Digital Science & Technology Museum of China is, based on the technical standards and codes, taking critical technology as the core and the Internet platform as a support, to establish a network application system integrated with a digital process, storage, and sharing service.

The process of constructing the Digital Science & Technology Museum of China has involved research and development of a great number of critical technology applications. The project will develop digital process tools for science popularization with independent intellectual property, such as a coordinated retrieval system, copyright protection of digital resources, digital construction of science popularization resources, three-dimension virtual modeling, high-quality real time picture processing, and game engines for the large number of fans and staff of science popularization. The key point is to research and develop a series of standard specifications for information resources integration and the sharing of digital science popularization, to develop critical technology, and to establish a sharing service network platform, which takes centralization as major and decentralization as minor by integrating available technology. It solves two key issues: one is how to integrate national science popularization products and information resources to realize a sharing service; another one is

how to realize the science experiencing function of a digital science and technology museum to attract a wide audience, especially adolescents, who wish to learn about science at the popular level.

## **4 PROBLEM ANALYSIS AND SOLUTION**

The construction of the Digital Science & Technology Museum of China is groundbreaking, which means that it will be confronted with many unprecedented issues. Under the precondition of completing a high quantity of construction, it also must ensure the quality of the resources to be displayed. Therefore, several issues must be managed.

### **(I) How to integrate the wealth of science popularization resources and how to share them effectively**

It is difficult to bring about the integration and sharing of science popularization resources. First, the resource allocation of science popularization is broad and hard to figure out. National science popularization information is dispersed across industries and departments among many institutions and individuals, making it difficult to collect, integrate, and share. Second, the contents of science popularization information resources cover many areas of science, which are difficult to assess and classify. It is also difficult to identify one standard by which the public can experience scientific knowledge from various subjects and easily retrieve the content and related knowledge of the Digital Science & Technology Museum of China.

An integrated information service with knowledge-based capability can provide all information and knowledge for a specific subject area. It also can provide different display forms during the process of presenting a knowledge point of view. An interdependent, integrated knowledge framework with hierarchical structure must be formed by connecting the knowledge hierarchies contained in each virtual museum, virtual experience museum, and science popularization resources library. However, insufficient financial investment and weak awareness of the possibilities of sharing knowledge restrict the quality and quantity of available information resources for integration and sharing.

Combining social awareness with expanded capital resources and mobilizing the enthusiasm of the society to participate in the construction of this project will be an effective approach for resolving the problem.

### **(II) How to realize the scientific education function of a digital science and technology museum to attract the public**

The public's participation rate is a major evaluation index of the construction's achievement. Under the precondition of achieving the objective of project construction to improve the participation rate of the public the following issues must be noted.

**1. To handle the relationship between science and entertainment.** Because online games with elaborate pictures, special effects, excellent audio effects, and fighting scenarios dominate much of the Internet, how an Internet-based virtual science experience attracts the public, especially adolescents, is a problem worthy of study and resolution. If scientists, scientific authors, and online game designers cooperate to present original, interesting scripts, with the three-dimensional technology of game development software in virtual exhibitions, the public will be eager to use these online virtual exhibitions, as scientific games and the experience of science become entertainment.

**2. Handling the relationship between accuracy and popularity of scientific knowledge.** The design concept and expression of the virtual museum and the virtual experience museum should not be overly scientific in order to avoid difficulty for the public during use. For example, there is a virtual museum of ancient machinery introducing an ancient water conduit. The public does not want to know how to assemble the conduit or the unfamiliar names of the parts but to learn how it runs and the theory involved in its operation. Thus designers need to compile excellent scripts from the viewpoint of the user to spread the scientific knowledge contained in the museum. Therefore, to provide expertise to the public, the digital science and technology museum should consider the knowledge structure and knowledge requirements of non-professional people in order to select the necessary knowledge and to get rid of the traditional “preaching” pattern. Meanwhile, the relevance between each knowledge point and the corresponding science and technology field should be emphasized to inspire the interest of the public in science.

**3. Resolving the discrepancy between digital virtual scene and real experience.** The online science experience is different from visiting a real science and technology museum. The participant cannot be in a real situation and cannot have physical contact with real exhibitions. Also the experimental objects cannot have direct chemical and physical variation; this can only be displayed virtually by the computer in a visual mode. Therefore, except for selecting suitable material for online display, the construction of an experiential project of digital science and technology should use novel and scientific creativeness in a virtual reality display to achieve online and offline interaction to enable the participator to feel the real experience of a science and technology museum.

To sum up, the issues occurring during project construction should be constantly explored and reviewed in the performance of interactive services between the Digital Science & Technology Museum of China and the public with the goal of continuous improvement in project applications. The Digital Science & Technology Museum of China will develop a virtual exhibition of science for participators to experience the designing, fabrication, development, and experimentation of science to enhance the degree of participation of the public. Each participator may establish his own virtual laboratory and scientific experiment works online and be a constructor of a virtual exhibition of science experiencing.

## **5 PROJECT PROSPECTS**

As the major social force of science popularization, the China Association for Science and Technology together with the Ministry of Education and Chinese Academy of Sciences will implement experimental project applications by the end of 2006, close to the formal opening of the main system, and guide the project construction according to users’ requirements and opinions by combining all science popularization services nationally.

The construction achievement of the Digital Science & Technology Museum of China will be a simplified Chinese edition and will be issued to the public over the Internet. However, there are quite a number of villagers and inhabitants in western China who cannot learn about science and technology, experience scientific and technological achievements, and enjoy the dynamic convenient service of the Internet age in real time because of the restrictions of family economy or local social development. It can be seen that the performance of the achievement of the Digital Science & Technology Museum of China will be restricted by objective conditions, such as the coverage of computer networks and personal economic status. Meanwhile, the use of the simplified Chinese edition will restrict communication with other countries and its application in minority areas. Among



the overall objectives of the Digital Science & Technology Museum of China are: to attract excellent foreign science popularization resources, to enable the public, especially adolescents, in western rural areas and minority areas to experience and share the high quality science popularization resources, to inspire and cultivate the people's interest in science and technology, and to enhance their scientific and cultural knowledge. All the units participating in the project will need to perfect the service coverage and methods and enhance the social benefit and utilization ratio of the project achievement of Digital Science & Technology Museum of China to satisfy more and more requirements of the public for science popularization. Combining extended service with collecting user feedback will facilitate the improvement of service quality and enhance the service levels. This will function as guidance for integrating and developing science popularization which is even more suitable for the requirement of science popularization at grass root actively.

In general, the project of the Digital Science & Technology Museum of China should not only construct a group of high quality science popularization resources but also form an operating system for the integrating and processing of science popularization resources. It should launch a sharing service as well as establish a platform that provides science popularization resource sharing services for the whole society and serve to improve national scientific and cultural quality. This project of the Digital Science & Technology Museum of China encourages and supports other departments and social forces to participate in the construction of the project to integrate various high quality science popularization resources of society, thereby providing an even better sharing service for the public interest.