

## Big Data Based Information Construction and Open Management of University Laboratory

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**Keywords:** University Laboratory; Big Data; Informatization; Open

**Abstract:** This paper studies the development of university laboratories in the era of "Internet+". The paper points out the problems existing in the management of university research laboratories in the current big data environment, and puts forward the informatization construction and open management application strategies of university laboratories in the era of big data. This paper intended to provide references and suggestions to the laboratory managers of various universities and promote the establishment of intelligent and information-based open laboratories with big data technology widely applying.

### 1. University laboratories development in the era of Internet+

With the development of the computer science, various intelligent products and intelligent software systems begin to replace part of people's work. This improves greatly the work efficiency. Our behavior pattern has been transformed into a mass of data. The information obtained by the big data technology is objective, accurate and efficient, which solves many key problems of human's production and life, facilitates people's life, and makes social development more rapid. The spirit of innovation and openness advocated in the era of Internet+ and Big Data has been gradually integrated into the current field of education reform. Experimental teaching is an important teaching method for any university and is an organizational form of practical teaching. The disciplines involved in it have developed from experiments based subjects, such as chemistry, physics, medicine and other natural sciences, to finance, telecommunications, engineering, geology, design and others. The definition of "laboratory" is more extensive, from the simple teaching place of a certain kind of discipline to the "English language laboratory", "art university laboratory" and so on. The related laboratory management system and information operating system are generated too.

The construction and development of university laboratory has always been one of the important standards to measure the level of school running ability. The establishment of high - level laboratory has become an inevitable trend. In order to adapt to the construction application-oriented undergraduate colleges, conform to the development of high-level laboratories and meet the requirements of school teaching, various colleges and universities continue to reform the experimental teaching content and establish a new experimental teaching system. With a large amount of investment in the construction of colleges and universities, the scale of the laboratories in colleges and universities is constantly expanding, and the number and types of instruments and equipment are constantly increasing. The development of the laboratory is characterized by large scale, high-end equipment and strong comprehensiveness. However, with the continuous development of the laboratory, the laboratory management work becomes more and more complex and burdensome. The establishment of a laboratory management system based on network, information and intelligence has become an urgent problem need be solved<sup>1</sup>. Today, many universities have established primary network management system. But, to comply with the development of the era of big data, the level of intelligence and information is not enough. In the laboratory management of university colleges, there are still using paper archives, manual inventory records, and manual control of the laboratory environment. Teachers work as administrators, low

utilization rate of the laboratory, and the inconvenient for students to use the laboratory forms up a negative effect on the cultivation of innovative talents<sup>2</sup>.

## **2. Applying big data to the management of the open innovation laboratory**

**2.1 What is big data** Big data is the outcome of science and technology. With the development of the computer science, various intelligent products and intelligent software systems begin to replace part of people's work. This improves greatly the work efficiency. Our behavior pattern has been transformed into a mass of data.

Today, with the advanced science and technology, big data has been widely used. From the fields of urban transportation, aerospace, military, and administrative to fingerprint control, WeChat check-in and so on. Some big data can also be applied to scientific research and network. Information comes from the related scientific research and the network is huge, so the relevant staff need to process and analyze these vast amounts of data fast and in real-time, in order to obtain some valuable information. After completed the information processing, the relevant staff need to carry on a full range of analysis and explanation of the result. A full range of understanding and anticipation is needed too<sup>3</sup>. The McKinsey global institute defined big data as a set of data which scale is larger than traditional database software tools in data acquisition, storage, management, and analysis. It has four characteristics, mass of data scale, fast data transfer, a variety of data types, and value of low density. Big data technology is economical and efficient in data processing. Its objectivity and accuracy are not comparable to that of traditional data processing methods. Nowadays, big data can be used in various fields for information and intelligent management. Great attentions have been paid to its research work in the worldwide. Big data technology is also constantly updated with the progress of science and technology. Researchers improve the technology according to the specific needs of different fields. Therefore, the whole society has acquired a relatively complete knowledge system for the research of big data technology<sup>4</sup>.

**2.2 Existing problems in the management of research laboratories in universities under the current big data environment** In the Internet era, the application of big data technology is closely related to our production, life and study, and is widely used in all fields. For a long time, because the computer technology development in China is relatively backward, the information construction of laboratory management system has not keep up with the pace of the developed countries. In the early 1990s, China began to learn laboratory management experience of developed countries in areas such as petrochemical, medical. A sizable management system and management devices have been introduced. But, result from the limitation of technology, management methods and the concepts difference between China and western countries, most systems and equipment didn't come in handy. Nowadays, China's scientific research capacity has been greatly improved. Companies and departments are specially engaged in the development of laboratory systems. Supporting equipment can also keep up with the research and development of the system. The developed management system has been able to adapt to the requirements of domestic laboratories. All these promote the rapid development of China's laboratory information construction. Science and technology is always a process of gradual improvement. As the forefront of cultivating innovative talents, the teaching and research laboratories of university still have some problems under the current big data environment. Therefore, the author starts from the application status, discusses some problems in teaching and research laboratories of university under the big data environment.

**2.2.1 LIMS system development lags behind.** LIMS, the abbreviation of Laboratory Information Management System, is a system which uses computer technology, builds servers and databases according to the corresponding theoretical guidance, and establishes connections through network communication<sup>5</sup>. LIMS development has experienced a long historical process. Until 1860s, laboratory management was artificial. The 1960-1970s is a vital decade of LIMS thoughts in the west world to explore and demonstrate. Because of the computer technology was not mature, management remains manually. But LIMS has shown its advantages in single computer data management. Due to the limitation of the network technology, the efficiency of processing data with single PC is low. The additional functions development lags behind. Computer and hardware

facilities were expensive and easy to fail, so LIMS development was limited. From 1980s to late 1990s, with the rapid development of computer technology, the speed of computer data processing was greatly improved. The hardware cost was constantly reduced, and the database technology and network technology became more and more mature, which provided the technical foundation for the development of LIMS.

Nowadays, with the development of Internet technology, LIMS will gradually replace the laboratory manual management system with the assistance of other technology. The powerful data processing ability of LIMS is more and more prominent in the era of big data. The data transmission and sharing become fast and comprehensive. It is very intelligent for data analysis and management, and can reach the high requirements of informatization and paperless laboratory. While improving the level of laboratory management, it also provides data and decision support for experimental teaching. In China's universities with strong comprehensive strength, such as Tsinghua University, Nanjing University and Beijing University of Aeronautics and Astronautics, LIMS systems have been developed firstly, which matching specific disciplines. At present, these systems have adapted to the habits of Chinese users, but still lack of intelligence. For example, the expansion of functions cannot be guaranteed, the sharing of data across departments and schools is low, the data maintenance is not perfect, and the system cannot be well transplanted to other disciplines. Therefore, the development of LIMS software in China can not meet the requirements of high-level laboratories. In addition, in terms of laboratory management standards, Chinese laboratories, learn the excellent experience from developed countries, are gradually challenging the application of open laboratories through the improvement of LIMS. However, at present, due to the insufficient of information management, the purchased system lacks corresponding functions and the equipment update is slow, which can only open partially for single using inside the school<sup>6</sup>.

According to the investigation of the laboratory management in universities, the information storage and management technology used in the laboratory in China is still relatively lagging behind, which affects the timeliness of information transmission. Big data technology has been gradually applied in the laboratory management of Chinese universities and colleges, but the application of big data technology has fallen behind due to the backward information storage technology.

**2.2.2 Network management lacks intelligence and the utilization rate of hardware facilities is not high.** At present, China's higher education is gradually becoming popular, and the scale of laboratory construction cannot keep up with the growth of the number of teachers and students. In order to respond to the policies and strategies of cultivating innovative talents and meet the standards of innovation laboratories, university laboratories are also trying to create a better teaching environment, so the purchased equipment and software systems are becoming more and more complex and diversified, resulting in increased workload of laboratory managers. The analysis and management of information is still manual, the arrangement of instruments, labeling, checking of accounts, the explanation of information and so on are complicated and prone to error<sup>7</sup>. The newly added laboratory management equipment has a low utilization rate under the traditional management mode. Some of it has become a decoration, which is a waste of resource. In addition, the laboratory environment cannot meet the requirements of experimental teaching under the innovative mode. The traditional laboratory information management system is installed software on device one by one. Informatization and network is at a low level. It has the characteristics of single PC and static state. So, the university laboratory manual management mode is inadequate.

**2.2.3 Information security risks.** In the Internet based information age, the network brings convenience to people, meanwhile it also exposes users' information to the Internet. In particular, plenty data generated by specialized research laboratories in universities which are confidential. In the process of information transmission, some important academic information was divulged due to the immature management technology. Although some big data technologies are used in the management of research laboratories in many universities, it is still difficult to guarantee the security of data. So that, along with information exchange and sharing, managers, teachers and students should strengthen the awareness of information security management, so as to avoid unnecessary losses.

### **3. Strategies of university laboratory informatization construction and open management application in the era of big data**

#### **3.1 Change the mode of "student application + teacher management".**

Use big data in the management of open laboratories and replace the teacher management mode with the big data management mode. Collect information of teachers and students by using big data technology. Student can enter the laboratory by card or fingerprint. Student's identity authentication, intelligent monitoring of access controlling, and intelligent alarm are possible. It is also possible to use reservation mode. Students can make reservation by checking the usage states of laboratory and equipment through internet. This way can save the reservation time. Students can also use their spare time effectively and flexibly<sup>8</sup>.

**3.2 Build the Internet of things system through big data technology,** and implement the identification technologies of RF, IC card and QR code to achieve storage, delivery, repair, purchase and elimination management. Establish a comprehensive database for the inquiry and management of administrator information, student information, teacher information, laboratory information, experimental equipment and so on. For example, a QR code recorded in the network can be pasted on the instrument to facilitate the supervision and management of its use by terminals, such as computers or mobile phones, so as to discover hardware quality problems and maintain the normal operation of the laboratory in time<sup>9</sup>.

**3.3 Reasonably optimize experimental arrangements,** experimental items and the use of experimental equipment by statistical analysis of existing resources. Through comprehensive analysis of students' learning, experimental process, experimental effectiveness, necessity and practicality, provide decision support for teaching plan, practice arrangement and experiment content improvement.

**3.4 For private data, in addition to the big data technology,** such as fingerprint identification, the application of big data technology should be deeply involved in the information circulation. For example, big data technology can be used to verify whether the address and port of receiving information are safe, and data transmission can be interrupted if necessary. In addition, big data technology can be used to limit the scope of information transmission.

**3.5 Increase the openness of the laboratory,** at the same time, reduce the working pressure of the managers and teachers, give students more autonomy to conduct independent learning more freely, and improve self-study ability, independent thinking ability, knowledge application ability and innovation ability.

### **Conclusion**

University laboratory is the forefront of experimental teaching in universities and plays a crucial role in the cultivation of innovative talents. Under the background of big data era, informatization and open innovation laboratory are important measures for the country and universities to cultivate talents. Universities running can be effectively improved at the school level, while the national level is to cultivate the cradle of top talent.

From the theoretical research of laboratory management mode, to the development of laboratory relationship system, and then, to the implementation of management measures, it is necessary to comply with the contemporary development. The big data management technology should be fully applied in every section, and the laboratory should be managed by information technology through big data technology to give full play to the use of the laboratory.

This paper studies the development of university laboratories in the era of "Internet +". The paper points out the problems existing in the management of university research laboratories in the current big data environment, and puts forward the informatization construction and open management application strategies of university laboratories in the era of big data. This paper is intended to provide references and suggestions to the laboratory managers of various universities and promote the establishment of intelligent and information-based open laboratories with big data technology widely applying<sup>10</sup>.

## Reference

- [1]. Xiao, Fuli; Chen, Yongdang; Yu, Lin; Cui, Quanjuan. Joint promotion of open laboratory construction in universities under the background of Internet [J]. Satellite television and broadband multimedia, 2019 (09): 32-33.
- [2]. Wang, Ying. Research on efficient operation method of open laboratory [J]. Laboratory research and exploration, 2007 (07): 128-131.
- [3]. Zhang, Yang. Analysis on the improvement of university laboratory teaching quality and management level by big data [J]. Modern measurement and laboratory management, 2016 (05): 68-70.
- [4]. Liu, Jun; Li Junhua; Zhao Huijun; Ji Wei. Research on open innovation laboratory teaching management based on big data [J]. Contemporary education practice and teaching research, 2019 (12): 18-19.
- [5]. Yao, Li. Research of intelligent laboratory design based on the Internet of things [D]. Anhui University of Science and Technology, 2016.
- [6]. Qian, Yonggang. Design and implementation of laboratory management system in art universities [D]. University of electronic science and technology, 2013.
- [7]. Zhang, Ni; Jiao, Zhe; Liao, Wenbo. Thinking and exploration on the establishment of an open laboratory management model [J]. Journal of dongguan university of technology, 2014, 21(03): 114-116.
- [8]. Wang, Aichun. Design and implementation of laboratory reservation management system [D]. Jiangsu university of science and technology, 2018.
- [9]. Chen, Yuncai. Research on computer laboratory management model based on the Internet of things [J]. Computer products and circulation, 2020 (06): 141.
- [10]. Liu Cunsheng. Research on open management system of university physical health laboratory based on "cloud data" [J]. Light industry and technology, 2020, 49(04): 99-100.