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Application of LIMS in Quality Management of Environmental Monitoring Laboratory

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Abstract: *After China's entry into WTO, foreign laboratories have set up wholly-owned and cooperative laboratories, and their standardized laboratory management and quality assurance system have challenged environmental monitoring laboratories. The test report issued by the environmental monitoring and analysis laboratory is related to the national economy and the people's livelihood. In the whole process of environmental testing, all kinds of environmental testing technical specifications and analytical method standards promulgated by the state should be strictly implemented, and the analytical testing procedures and quality management requirements should be observed. In this paper, the application of Laboratory information management system (LIMS) in the quality management of environmental monitoring laboratory is studied. LIMS is an auxiliary tool to manage the laboratory by means of information technology. With the standardization construction of environmental monitoring business and the rapid development of business volume, the application value and potential role of LIMS in environmental monitoring departments have become increasingly apparent. LIMS realizes all-round management with laboratory analysis and testing as the core. It integrates many modules, such as sample management, resource management, data management, quality control, report management, resource management, etc., and forms a complete laboratory comprehensive management and product quality monitoring system, which can not only meet the external daily management requirements, but also ensure the strict management and control of laboratory analysis data.*

Keywords: *LIMS; Environmental monitoring; Laboratory quality management*

1. Introduction

In recent years, environmental pollution has become a major problem that affects economic and social development and people's daily life. Environmental monitoring is the prerequisite for good environmental pollution prevention and control, which can provide a reliable basis for pollution prevention and control. After China's accession to the WTO, foreign laboratories have set up wholly owned and cooperative laboratories, and their standardized laboratory management and quality assurance systems have posed challenges to environmental monitoring laboratories [1]. The test report issued by the environmental monitoring and analysis laboratory concerns the national economy and the people's livelihood. The whole process of environmental testing shall strictly implement various environmental testing technical specifications and analytical method standards issued by the state, and comply with the analytical testing procedures and quality management requirements. The environmental monitoring and analysis laboratory shall establish the corresponding laboratory quality control and management system. The laboratories recognized by the National Laboratory Accreditation Committee are reliable guarantees to achieve the above requirements. However, to achieve the expected effect of the quality management system based on various rules and regulations, effective supervision and management is the last. However, in the environmental monitoring work, the traditional implementation and management methods have been difficult to meet the actual requirements, which are manifested in low efficiency and information lag [2]. Therefore, it is necessary to adopt the laboratory information management system according to the characteristics of environmental monitoring work, and improve the implementation and management technology level of environmental monitoring with the help of the powerful functions of the system.

Under this background, the laboratory information management system began to appear, and it has developed rapidly in practical application, becoming a new laboratory management and application technology. Therefore, this paper studies the application of LIMS in the quality management of environmental monitoring laboratories. LIMS is an auxiliary tool for the management of laboratories

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by means of information technology. With the standardization construction of environmental monitoring business and the rapid development of business volume, the application value and potential role of LIMS in environmental monitoring departments are emerging. LIMS is a professional information system for various analysis and testing departments, which adopts scientific management concepts and advanced complex relational database management technology to automatically collect and transmit laboratory analysis data, online process control and authority allocation. It integrates multiple functional modules such as sample management, resource management, transaction management, network management, data management and report management, To form a complete set of comprehensive management and product quality monitoring system of information laboratory [3-4]. LIMS realizes all-round management with laboratory analysis and testing as the core. It integrates many modules such as sample management, resource management, data management, quality control, report management, and resource management to form a complete laboratory comprehensive management and product quality monitoring system, which can not only meet the external daily management requirements, but also ensure the strict management and control of laboratory analysis data [5].

2. Related theories of LIMS

The LIMS takes the laboratory as the center, organically combines the factors that affect the analysis data, such as the laboratory business process, environment, personnel, instruments and equipment, standard materials and liquids, chemical reagents, standard methods, books and materials, file records, scientific research management, project management, customer management, etc., and adopts advanced computer network technology, database technology and standardized laboratory management ideas to form a comprehensive and standardized management system. Business process management is the most core subsystem of LIMS, which mainly includes the whole monitoring process of business acceptance, monitoring plan preparation and approval, on-site sampling, sample registration and management, analysis task assignment, detection process management, monitoring result registration, monitoring result audit, report preparation, report approval, report printing and sending, and business filing [6-7]. Issue and assign tasks through the network; Automatic data acquisition and rapid analysis; Information sharing; Results are paperless; Implement an efficient quality assurance and safety guarantee system; Control the effective cost and schedule; Quantitative assessment of staff; Improve the technical level of laboratory information management. The function of LIMS not only comes directly from users' needs, but more importantly, it comes from LIMS manufacturers' careful analysis of users' real needs. It comes from LIMS manufacturers' understanding and control ability of network technology, database technology, data communication, information management and other disciplines. Staff can access the working interface they can see through user login, and the interfaces seen by different users are different. For example, staff in the business room can see the sample reservation module, sample acceptance module and task assignment module, thus further improving the reliability and security of the system. The structure diagram of LIMS is shown in Figure 1.

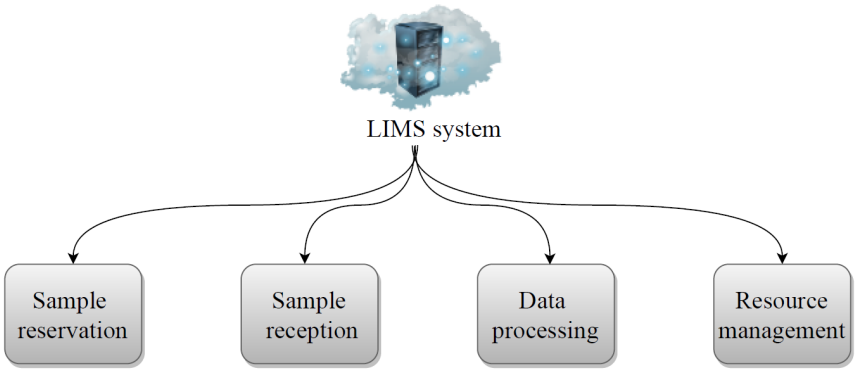

Figure 1: LIMS Structure Diagram

LIMS can realize instrument and equipment account management, traceability management and equipment online management. The equipment account is used to manage and store all information of instruments and equipment, and provide daily maintenance and inspection procedures and verification methods. LIMS can process the original data for the second time, and provide various statistical data for senior management to analyze and make decisions; The system can receive the data transmitted from remote detection instruments in real time and online, know the working status of each instrument

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and equipment in the system, record the users and switch on time, and build an integrated system of comprehensive management and quality monitoring around the laboratory with the help of computer platform [8]. Its construction center is the laboratory. The management system includes computer and its network technology, database and modern laboratory analysis management concept, which can control the use of authority, greatly improve the management efficiency of managers and the working efficiency of operators. It is an information platform to connect laboratories, production workshops, quality management departments and customers by providing technical support in various aspects such as overall improvement, while introducing advanced mathematical statistics technologies, such as variance analysis, correlation and regression analysis, significance test, cumulative sum control chart, sampling inspection, etc.

3. The Role of LIMS in the Quality Management of Environmental Monitoring Laboratory

3.1. System operation management

The quality management system in laboratory accreditation includes system operation structure and resource control elements. Correspondingly, according to the actual situation of the quality management system and business requirements of Qidong Environmental Monitoring Station, the LIMS of Qidong Environmental Monitoring Station has two functions in quality management: system operation management and resource management. During the operation of this subsystem, the testing tasks of the laboratory are clear at a glance. The management personnel and quality supervision personnel at all levels of the laboratory can master the progress of any monitoring task in real time and understand the current working status of each testing personnel [9]. The reservation of equipment can be realized, and the user can use the instrument under the control of permission and time limit; It can quickly count the data such as machine day size instruments, number of people, machine hour personnel, and machine hour items, quickly evaluate the utilization of equipment, and improve the quality of asset management and asset service. The staff of the monitoring center shall ensure the smooth operation of the system through the establishment of the system after mastering each operation link. Based on this, the management of the Monitoring Center has held relevant meetings for many times, followed the basic principle of group policy and group discussion, formulated a number of systems successively, and established the basic responsibilities of different departments, so that the responsibilities can be implemented in place and the division of labor is clear, laying a good foundation for the smooth operation of the system.

Understand the monitoring instruments, reagents, environmental conditions and other information involved in the monitoring, and be able to identify potential nonconformities and nonconformities in the monitoring work in a timely manner. During the sample analysis process, when the LIMS equipment management system detects that the equipment necessary for the method is not working, it indicates that the test results have errors, and identify the severity of nonconformities, and take preventive and corrective measures, It has greatly improved the timeliness of non conformance discovery and response measures, improved the efficiency of quality management, and significantly improved the process control ability [10]. When we input the number of samples M and the number of tests N, we can calculate the mean value, standard deviation, etc. according to the formula for calculating the error. If we introduce the information of testers and laboratories, we can further carry out laboratory comparison and evaluate the repeatability and reproducibility of the method. After laboratory analysis, the system will automatically summarize the data and provide evaluation data, and generate different forms of reports according to actual requirements. At this time, the staff should review the data. If any problem is found, it should be returned for modification. After the review and confirmation, it can be submitted.

3.2. Detection resource management

Establish archives of monitoring personnel, including technical archives and health archives. Establish a personnel file card to comprehensively record the changes, work experience, violation of discipline, awards, qualifications, training, assessment results and other recorded information of the monitoring personnel, as well as the records of regular health check-ups and accidents. Analysts, quality management personnel, and computer technicians comprehensively put forward accurate, complete, and reasonable requirements, and all staff are required to improve their quality management awareness, improve their computer application level, and learn relevant knowledge of software engineering, database technology, communication, and network technology [11]. LIMS is the

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informatization and standardization promotion of laboratory quality management, which makes it strictly follow the quality assurance system of ISO17025, ISO9002 and other standards, and is in line with international standards, thus improving laboratory management level and speeding up decision-making. The successful implementation of LIMS has clear quality management requirements, and at the same time, clear system design scheme and ideas play a decisive role in the management software. Therefore, the suggestions of LIMS in environmental monitoring laboratory quality management are put forward, which are mainly divided into three aspects, as shown in Figure 2.

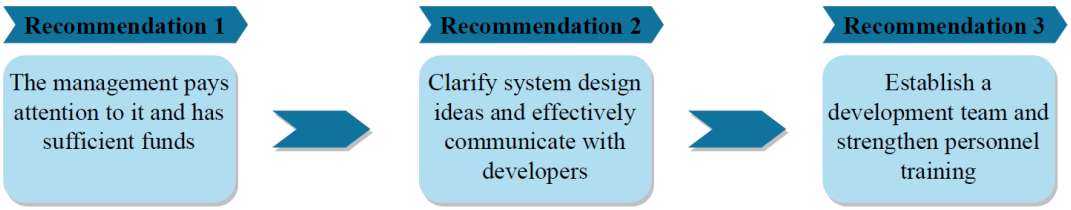

Figure 2: Suggestions on quality management of LIMS in environmental monitoring laboratory

Realize automatic registration of measurement calibration and period verification records. Within the set number of days of advance reminder, the instruments that need to be traced within this number of days will be automatically displayed. The system can remind and restrict the application of equipment that fails to complete the verification, calibration or periodic inspection in time. Actively participate in the design and testing of LIMS. Only in this way can the possible advantages of LIMS technology be transformed into tools that people in different positions are happy to use, which can effectively improve management efficiency and quality management level. There are hundreds of monitoring projects, involving more than 200 monitoring methods and specifications, and more than 100 forms, all of which require application personnel to conduct functional requirement analysis and research according to their own business and management functions, and to communicate effectively with software developers. In this way, software developers will be more handy when developing software, which will greatly shorten the development cycle and minimize the cost of manpower and material resources.

4. Conclusions

With the development of economy and society, the importance of air quality monitoring has become increasingly prominent. According to the actual situation of air quality monitoring, people need to constantly take measures to improve the level of air quality monitoring, so as to give play to the effectiveness of air quality monitoring and promote the rapid development of environmental protection. Therefore, the application of LIMS in the quality management of environmental monitoring laboratories has been studied in this paper. The construction of LIMS is a systematic project that covers a wide range of areas, has a large scope of influence, and costs both energy and money. Any LIMS general product should be re developed according to the needs of users, and then become a customized product. The development process requires the common vision, design, coordination, decision-making and implementation of both the LIMS supplier and the user. The efficient and orderly operation of the LIMS can effectively implement the quality assurance and quality control processes, allowing personnel in different posts to share information resources within their respective authorization scope. The process control ability of the quality management personnel has been significantly improved, ensuring the programmed operation of the management system. LIMS technology is a necessary management system technology for laboratories that follow the international standard quality management mode, and is a powerful weapon for laboratory information construction. Although it is still difficult to promote the construction of LINS in the environmental monitoring laboratory at present, in view of its broad application prospects, LIMS will certainly promote the management level of environmental laboratories in China, greatly improve the management ability, testing and calibration level of laboratories, and improve the working efficiency of laboratories, which is an inevitable trend of laboratory management.

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