

Design and implementation of computer simulation laboratory construction system

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Abstract. The design and development of computer simulation laboratory construction system provide certain technical supports for the improvement of relevant theories in all sectors of our country. By reading and summarizing the related data, the related concepts of computer virtual laboratory construction system were summarized, and the simulation of the meteorological laboratory construction system was also taken as an example. Compared with the actual setting value, the error was relatively small. The results show that the computer simulation laboratory construction system is more suitable for today's industry development. The purpose of this research is to provide theoretical basis and technical support for the development of related industries in China.

Key words. Computer, simulation, laboratory construction system.

1. Introduction

With the development of the times, the world economic level has been greatly improved. In this trend, various industries have also been greatly improved. Various new theories and techniques have been gradually applied to the development of the industry. However, how to determine whether a theory or technology is necessary for the development of the times and the progress of enterprises is necessary, and how to judge a theory is more accurate and more reliable is of great importance. Under this problem, the importance of the laboratory is beginning to be highlighted. The laboratory is extremely important for the development of the industry, it can further improve the relevant theories through the experimental design of some problems raised by the industry, so that the relatively imperfect parts of these theories are improved, and the relevant theories and techniques can provide greater impetuses to the development of the industry. Therefore, as an important link of theoretical and technical verifications, the development of laboratory is of great importance to the

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development of an industry or an area. Especially in today's era of theoretical and technological innovations, it is necessary to make real-time evaluation and analysis on all relevant theories, so that more advanced theories can be created and perfected continuously, thus providing a scientific basis for the promotion of the overall level of the industry as a whole. However, in the construction of laboratory, there are great risks and high costs. For example, in the laboratory construction, if the relevant laboratory construction link in a timely manner cannot be controlled, risks may arise in the construction of certain links during the process, which has some negative effects on the subsequent experimental operations and theoretical verifications.

2. State of the art

In the current era, with the development of various industries in the world, the demand for more new theoretical knowledge has become one of the main concerns of various industries [1]. In many industries, many theories in these industries are presented in the form of hypotheses. Therefore, in the development of these industries, it is necessary to guarantee the relevant theoretical knowledge can be combined with the actual development of the industry in the process of development, so as to achieve the organic combination of industrial practices and theories and provide more positive impacts for the development of the industry [2]. Therefore, the construction of laboratories has become a top priority in the development of various industries, and many industries have constantly updated their related laboratory equipment, so that the final evaluation results of the experiment have higher credibility, and the data is more authentic and reliable, so as to provide a certain technical support for the progress of the industry ultimately [3]. In the traditional laboratory construction, the whole experiment is done through manual operations, and there are many risks, for example, there are a large number of toxic and harmful gases, so that the body of the relevant personnel will suffer a certain degree of damages. And in the construction, if the relevant links cannot be timely controlled to assess its various links on the basis of the completion of the comprehensive evaluation of the entire laboratory construction, it will have a negative effect on the construction process of the laboratory, and then it will also affect the whole operation process of the laboratory [4]. The appearance of computer simulation system provides technical supports for the development of the laboratory construction, and many research scholars begin to study and analyze this link, which provides more theoretical supports for the improvement of the laboratory construction process.

3. Methodology

With the development of the times, the overall economic level of the world has been greatly improved. In this trend, countries around the world have begun to pay more attentions to the development of their various industries, and more advanced theories and techniques have been introduced into the development of various industries. And with the rapid development of the industry, many more correct and

reliable theories are applied gradually, while there are many inaccurate assumptions which cause some limitations for the development of the industry [5]. Therefore, the relevant theories and technologies need to be verified in a timely manner, so as to ensure that more accurate information can be applied to the development of the industry, which is extremely important to enhance the overall strength of the industry. Since China's reform and opening up, the contact with the developed countries has gradually increased, and the comprehensive strength of various industries in China has been greatly improved. In this situation, China has also begun to introduce related theories and technologies from many developed countries [6]. However, whether the relevant theories and technologies that are introduced can be combined with the actual situation and demand of our country is one of the important issues that should be considered when introducing relevant theories and technologies. Many advanced theories and techniques have been verified to some extent in the later stage, so the development of our country's industry level, China's economic level, the overall strength of the country and the international status have been greatly improved [7]. However, because of the blind use in the process of introduction, there are some theories that cannot be better combined with the actual situation of our country and the actual demand of the industry development, they have a certain negative impact on the development of China's industry, and the related costs in the development of some industries in China increase, so they fail to obtain relevant incomes, thereby hindering the progress of the industry [8]. In this uncoordinated phenomenon, our country begins to build various types of laboratories, and the laboratory is verified firstly through the introduction of relevant theories and techniques. On the basis of the expected effect in a small environment, the relevant theory is further applied to actual industrial production, which can greatly reduce the risk of the development of the industry, and it may also provide a basis for the development of some new theories and innovative technologies in our laboratories [9]. Therefore, the establishment of laboratories is very important for the development of various industries in our country (Figure 1). However, in the process of increasing the number of our laboratories, although it provides more related theories and techniques with innovative values for the development of the industry, there are also some unharmonious factors that also need to be further considered. For example, in the construction of laboratory, the arrangement and use of related instruments and equipment in laboratories are important links of laboratory constructions. Because our country still lags behind the developed countries in some aspects, the construction of some specialized laboratories remains at a relatively backward level, so that the initial construction of the laboratory is not reasonable. This may result in the harmful poisonous gases produced by some chemical experiments or biological experiments in the course of experiments, which cannot be eliminated in time because of the construction, thus causing certain losses to people's bodies; because some of the more expensive instruments are not properly placed, which may do damage to the equipment during use, thereby increasing the overall experimental costs or indirect costs; in the course of some experimental operations, some of the more important laboratory links may not be better connected because of the unreasonable design of the laboratory, which may have an impact on the accuracy and reliability of the

experimental results, thus affecting a series of subsequent verification processes, and it will also result in an increase in the cost or time cost of certain experiments or a failure of the experiment. In serious cases, it may lead to erroneous theories and cause irreparable damages to the development of subsequent industries. Therefore, the design of the laboratory is very important for the development of the whole link of the experiment [10].



Fig. 1. Laboratory development

In view of a series of discordant phenomena above, through the analysis of the relevant data, the relevant theories of the computer simulation laboratory construction were determined, and the advantages of laboratory construction under this technology were further analyzed, so as to determine the theoretical basis of this study; on the basis of the theory, the main influencing factors of the computer simulation technology for laboratory construction were generalized; and based on the importance and advantage of computer simulation technology, the comprehensive evaluation of its related construction links and the final construction were obtained by taking the laboratory construction of a university as an example, so as to validate the study from an example point of view; through the questionnaires for relevant university laboratory managers, a comparative analysis of the mode of laboratory construction based on computer simulation and the traditional laboratory construction method was made in this paper, so as to confirm the necessities of the development of this technology and provide more authentic and reliable data supports for the follow-up researches.

The computer simulation technology in traffic weather laboratory was selected as the actual laboratory operating platform. Firstly, the atmospheric visibility correlation model of fog simulation systems in the meteorological observation was established by the computer simulation system. Among them, the formulas of the extinction coefficient, visibility and other parameters in the meteorological observa-

tion are shown as follows:

$$Vis = -\frac{\ln \varepsilon}{\beta}, \quad (1)$$

$$\beta = \pi \sum_{i=1}^N Q_{\text{ex}} n_i r_i^2, \quad (2)$$

$$u(t) = K_p [e(t) + \frac{1}{T} \int_0^t e(t) dt + T_d \frac{de(t)}{dt}]. \quad (3)$$

In the above equations, Vis represents the extinction coefficient, ε and β represent the correlation coefficients, Q denotes the actual observation, n denotes the number of actual observations, $u(t)$ represents the visibility parameters, T is the model of associated value and values of K_p represent P .

Then, the coefficients of the related model were optimized to make the model better. The main optimization scheme is shown in Table 1. By analyzing several schemes of correlation coefficients, the optimal operational parameters for the study were determined.

Table 1. Optimization schemes of correlation coefficients

Parameter estimation scheme	Extinction coefficient model	a	b
Kunkel scheme	$\beta = 144.7W^{0.88}$	144.7	0.88
Eldridge scheme	$\beta = 91.0W^{0.65}$	91.0	0.65
Pinnick scheme	$\beta = 145.0W^{0.63}$	145.0	0.63
Tomasi scheme	$\beta = 65.0W^{0.67}$	65.0	0.67

4. Result analysis and discussion

Today, our country has begun to take the design of laboratories as an important part of the experiment, and it has attracted more attentions of scholars. With the emergence and development of computer technology, many scholars have begun to apply the computer simulation technology to the construction and evaluation of the laboratory, and they have achieved considerable results [11]. However, the research in China is still in the initial stage, and the related theories and techniques are not mature enough. In order to improve the related theories and technologies, the design theories of computer simulation laboratory construction system were analyzed and generalized in this research. The research aims at providing a reference for the development of computer simulation laboratory construction system in our country, and further providing technical supports for the development of related industries.

The development of laboratory and its role have become more and more impor-

tant in the current era of rapid economic developments. No matter what the industry is, it is inseparable from the understanding of the development of relevant theories and knowledge. On this basis, more theories are verified and analyzed, so as to put forward more innovative theories and technologies and provide a theoretical basis for the development of the industry as a whole. The construction of the laboratory is one of the most important prerequisites for the accurate operation of the entire experimental operation [12]. In the various industries of the world, many scholars have started to take the construction link of laboratories as an important prerequisite for laboratory researches. For example, in the chemical or biological industry, a large number of experiments are needed to verify the relevant theoretical knowledge in the field. In the course of the experiment, there are more polluting drugs in the chemical or biological industries, and the design of the laboratory may be harmful to the human body because of the unreasonable design of the laboratory; or in the physics industry, the related instruments and equipment with radiation may be exposed to the industry and the structure of the laboratory is irrational, it may cause more radiations, which will restrict the development of the whole industry. Moreover, some experimental operations may involve the use of expensive instruments and equipment. If the design of the lab is not reasonable, it may cause some mistakes in the process of use, thus affecting the integrity of the expensive equipment in the laboratory, which will lead to an increase in the cost of some experiments and have a negative impact on the further development of laboratories [13]. Therefore, in the laboratory construction, it is necessary to evaluate and analyze the relevant aspects of laboratory construction in a timely manner, so as to confirm the perfection of the whole construction link and then provide certain guarantees and positive influences for the follow-up experiments. There are many related links in the construction of laboratory, and many scholars have analyzed and explored them and have made great achievements. The advent of computer technology has brought a new technical support for the development of various industries. And because of the existence of related characteristics of the computer technology, this technology can be better combined with related industries, thus forming a new model of development [14]. Under this trend, some of the computer's techniques such as computer simulation systems have also been gradually introduced into the laboratory building (Figure 2). In the construction of simulation laboratory system based on computer, the main thing is to introduce the computer simulation technology into the actual laboratory construction, and through the use of the system, all kinds of evaluation indexes are collected in real time in the whole laboratory construction. And through the computer simulation system, the whole construction process can be analyzed and evaluated, so that the late construction has some basis and the whole construction process is monitored in real time, thus evaluating the rationality of the whole process construction [15]. Therefore, compared with the traditional construction model of subjective judgments, the construction of laboratory based on computer simulation system can obtain relatively large basic data and more perfect evaluation models, and it considers the problem more comprehensively, so that there are more reliable basis and data supports in the late construction.

On the basis of the clarity of relevant theories, a laboratory for fog detection in a



Fig. 2. Development of computer simulation laboratory construction

weather processing laboratory was further built. The main links in the construction of the fog laboratory based on computer simulation system included data acquisition, data processing and data analysis. The major simulation building facilities are shown in Table 2.

Table 2. Components for the construction of this computer simulated fog laboratory

Visibility setting point (m)	Conventional laboratory measurements (m)			Computer simulation laboratory measurements (m)			Error value	
	1#	2#	3#	4#	5#	6#	Absolute error (m)	Relative error (%)
200	203	208	210	204	213	212	9	4.5
150	153	161	156	151	159	159	6	4
100	94	98	93	97	94	93	7	3
50	53	52	54	53	49	52	2	4

Then, by setting different visibilities and using the constructed computer simulation techniques, the laboratory technique and the traditional laboratory technique were compared and analyzed, as shown in Table 3. The absolute error and relative error of the set value of visibility in experiments and computer simulation systems were analyzed. The results show that the error of computer simulations of the fog laboratory is relatively small, and it is more convenient and reliable for laboratory operations.

Table 2. Components for the construction of this computer simulated fog laboratory

Name	version	Technical parameter specification	Number
Touch screen	version	Technical parameter specification	Number
Programming cable		6ES7 810-4CC07-0YA5	1

5. Conclusion

With the development of the times, every industry has made a great progress, and more advanced theories and technologies have been introduced from developed countries to some backward countries because of the increasing exchanges between countries. In this trend, a large number of laboratories have been set up and established for validation of relevant theories. However, in the traditional laboratory construction, some non-standard construction methods may cause certain harm to human health and increase the cost of researches. The theories and techniques of computer simulations of laboratory designs have begun to be used in traditional laboratory operations. The related theories and techniques of the laboratory design of computer simulation technology were summarized in this study, and the model was used in the fog laboratory as a practical case to compare and analyze the computer model laboratory construction system. The purpose of this research is to provide a theoretical basis for the construction of computer virtual laboratory in China. Due to the lack of relevant theories, the depth of the discussion needs to be improved. The following researches should consider all kinds of influencing factors in the construction of computer virtual laboratories, so as to provide better references for the development of computer virtual laboratories in China.

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Received May 7, 2017

