

Laboratory Management Model Based on the Soft System Analysis Method

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Keywords: Laboratory Management; System Theory; Soft System analysis Methodology.

Abstract. Laboratory system is an open, complex, gigantic system which includes laboratory space, equipments, structure parts, models, function devices, elements, experimental projects, teachers and students. From the viewpoints of credit-based cultivation mode of colleges and universities, the information technology is needed to assist the implementation of flat management and omnibearing open of laboratory with high efficiency. Using the method of soft system analysis (CATWOE) to analyze the laboratory system, we can obtain the laboratory management system with whole life cycle of laboratory. In which, the asset (equipments or devices) management is the base of laboratory management system. The construction of experimental teachers is the premise of laboratory management system. The project of experiments is the core. The acquisition, evaluation and feedback of information are the keys of laboratory management system. Consequently, the laboratory management system is comprised of 6S spot management, asset management, experimental teacher management, student management, and experimental project management. The laboratory management system can efficiently guarantee the implementation of experimental projects of the type of verification experiment, comprehensive experiment, and innovative experiment. Ultimately, we can achieve the goal of credit-based cultivation with architecture of experiment, practical training, innovation and entrepreneurs practice.

Introduction

Laboratory can be defined as an entity of teaching and scientific research, which has basic scale of person, property, thing, and task. From the point of view of system structure and function of system, the structure and function are the two most important elements of laboratory management [1]. The structure of laboratory management denotes the vertical function management part, while the function of laboratory means the horizontal experimental project management. The establishment and operation of laboratory is closed related to the mode of teach and research. As a result, the management mode of laboratory is determined by the organization structure, teach mode, and training plan. With the economic development and social progress, on one hand, the scale and investment of the colleges and universities is larger and larger, which result the type and number of laboratory larger than before. On the other hand, the teaching evaluation and professional certification of colleges and universities dominated by third party is more and more fine and scientific, which require more detail and scientific performance evaluation of laboratory of colleges and universities. Consequently, the laboratory management is relevance directly to the performance of teaching and research of colleges and universities. These assert more requirements to the management of laboratory, the construction of organization, rules and regulations. Which require the laboratory management transferring from unitary type to intensive type, from hierarchy type to flattening type [2, 3], implementing omnibearing open [3, 4, 5], and aiding by the information technology.

Soft System Analysis method of Laboratory Management

Laboratory is one of the most elements of colleges and universities. From the viewpoint of system theory and system engineering, there need combine the circumstance of laboratory, i.e. the colleges and universities to system analyze the laboratory [6]. On one hand, with the economic development and social progress, the colleges and universities have put forward construction high-level university to cater the trend of the times. On the other hand, the teaching evaluation and professional certification of colleges and universities dominated by third party raise a newly claim to the colleges and universities. These require the novel types for enrollment, organization management, teaching mode and method of colleges and universities. In which, the most important issues are the establishment of teaching idea of “thick foundation, wide aperture”, and the transferring of teaching mode from the academic year system to the credit system. Meanwhile, the teaching idea and credit system require training plan with modularization as general courses, liberal arts courses, professional basic courses, and professional courses. The innovation and practice training system include the stages of experiment, training and innovation, entrepreneurial practice, in which there are three levels training project: verification experiment, synthesis design experiment, and innovation experiment. The upcoming credit-based training plan and innovation architecture play an important role in the establishment and operation of laboratory. In which the laboratory can be divided as the kind of verification, synthesis, and innovation by function, the types of experiment, training and innovation, entrepreneurial practice by stages, the styles of teaching, research, and combination.

From the viewpoint of system theory and system engineering, the combination of the laboratory forms a system, while the laboratory management is also can be seemed as a system which is the superset of the system formed by laboratory. Laboratory management may include the development of organization which has responsibility to the laboratory management, the implement of rules/regulations and operation flows to management the elements of the system, spot 6S management [7], the operation of equipments and devices, and the project of experiment and research. While the establishing of organization, the formulation of rules/regulations and operation flows, and laboratory management is the movement relations between the laboratory management and its environment. The movement relations are embodied in the forms of material, power, and information of the system. The equipments and devices belongs to material, the electricity power need in the running of equipments and devices may be part of power, while the status of the stages of the operation of equipments and devices is in the form of information. In the operation stages of the laboratory, there are always exist the exchange between the system and its environment in the forms of material, power, and information. Consequently, laboratory management is an open system from the viewpoint of system theory and system engineering.

In the operation process of the project in laboratory, there may be exists combination of equipments to complete an experimental project. While equipment maybe comprised by several structure parts, a structure part is consisted of many models, model is made up of functional devices, and the functional device is formed by elements. Thus we can view the process of an experimental project as the movement result of the “training plan-student-project-laboratory-equipment-structure part-model-functional device-element” architecture system from the viewpoint of system theory and system engineering that things are universal motion and contact.

The hierarchical division is compatible with system theory and system engineering. The architecture division, scope and scale of a system are determined by the needs of the problem analysis from the viewpoint of system engineering [6]. There are nine layers in the system to complete the experimental project. So from the viewpoints of the system theory and system engineering, the system of assets which accomplish the project in the ways of combination of laboratory is a complex system.

With the economic development and social progress, the project of experiment, practical training, and innovation practice become more complicated and huger in scale. Thus result the combination system of laboratory becoming more sophisticated and larger in number. So from the point of view of system theory and system engineering, the asset management is a gigantic system.

In conclusion, the asset management can be view as an open, complicated, gigantic system in the

point of view of the system theory and the concept of development [6]. In order to complete laboratory management task, we must adopt the analytical method of open, complicated, gigantic system to analyze the laboratory management system [8].

Laboratory Management Model

For the open complicated huge system of laboratory management, we must adopt the system theory to analyze it. The laboratory system not only include hard object such as equipments, but also include soft element such as experimental training plan, project, rules and regulations. So we take the soft system analysis method CATWOE to analyze the system [8]. The soft system analysis method can be described as: in the guidance of weltranschauung W and the restriction of environmental constraints E, the actor of A transfer T the input to the output, and influence the custom C. In which O is the colleges and universities, W is the training plan, E is the space managed by 6S, A is the teachers, C is the student. While the input and output mean the experimental project in the stages of experiment, practice training, and innovation practice. In the analysis of soft system method, the training plan plays an important role for the experiment project taking place in the laboratory. The laboratory is just the spot of 6S management. The teachers responsible for the 6S management and is the instructor of experimental project, while students are the participants of the 6S management and experimental project. The equipments or its combination are the tools of experimental project. In the laboratory management system, in order to give consideration to the experiment of verification, synthesis, and innovation, we must transfer the unitary laboratory to intensive laboratory [2, 3] by the principal of development of subject and the course architecture of experiment. In order to increase the efficiency of laboratory management, the administrative system of laboratory must shift from the multilayer of “university-college-subject” to the flat architecture based on the experiment center, which can overcome the shortcoming of the laboratory subordinate to the teaching and research section. In order to ensuring the differentiation cultivation under the credit system, the traditional laboratory must transfer to the all-around open laboratory [3, 4, 5]. Thus we can complete the cultivation with varieties of students, architecture, and experimental project. Ultimately, with the aid of information technology, the flat and long span management can be achieved in the laboratory management.

The conception of system is relative on the viewpoint of system theory and system engineering. From this issue we need contact system to analyze the elements or parts of system, while studying system ought to take the environment or the surroundings of system into account [6]. In laboratory management, the basis is the asset management, the premise is the 6S management of spot, the guarantee is teachers, the subject is students, the experimental project is core, the acquisition, feedback and evaluation of information is the key. Thus we can obtain the whole life cycle management covering all stages of laboratory: The whole life cycle management of laboratory includes spots 6S management, asset management, teacher management, student management, and experimental project management. The model of laboratory management is illustrated in figure 1 as following:

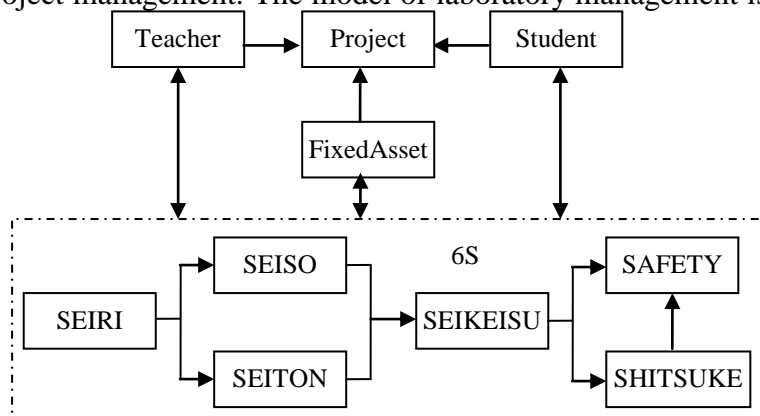


Figure. 2 Laboratory Management Model

In figure 1, the 6S management of spot maintains a safety and efficiency space for the experimental project. The 6S management is responsible for the efficient management of person, machine, material, method, environment, information in a specified space. Asset management maintains proper operation status of equipments, which is the base of the implementation of experimental project. Teacher management mainly refers to the construction of teachers and ensures the implementation of experimental project. Student management means properly training student to abide the rule and regulation of experimental project. The experimental project is the core of system, which link the asset, teacher and student.

Summary

Laboratory management model based-on the soft system analysis method adopts the system theory to management the whole life cycle of laboratory. In which, the asset management is the base of laboratory management system. The construction of experimental teachers is the premise of laboratory management system. The experimental project is the core. The acquisition, evaluation and feedback of information are the keys of laboratory management system. Improving the operation performance of laboratory can be achieved by the construction of organization, and the construction of rules and regulation. Ultimately, the laboratory management can guarantee the quantity and quality of cultivation in the mode of credit system of colleges and universities.

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