Method for sharing test data based on blackboard model

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Abstract. With the accelerated development of the equipment under test towards informatization and systemization, higher requirements are put forward for the construction of the test capacity of the equipment under test. It is a good way to maximize the value of test data as a core resource through building a test data distributing and sharing platform. A test data distributing and sharing method based on the blackboard model is proposed in this paper. Then a data sharing model is established including data management service center, data demanders, and operating mechanism to meet the needs of remote storage and global sharing of test data.

1. Introduction
The rapid development of information technology has promoted the accelerated development of informatization in various fields of society. With the advent of the "big data" era, the construction of data resources presents an unprecedented "multiplier" role [1]. In recent years, various information systems have been put into use one after another, and the basic conditions of network operation have been significantly improved, which has effectively promoted the construction of test capabilities based on information systems. However, it also shows urgent requirements for the construction of data resources [2-3], which highlights the data The importance of resource construction, sharing, management and the development of big data products, build a test data exchange and sharing platform, develop a test data interactive sharing management system, provide data sharing and exchange and service guarantees as needed, and achieve hierarchical management and control of test data resources, unified scheduling and On-demand service.

For a long time, subject to the constraints of task division factors, the test resources of test institutions are generally constructed independently and self-contained by each sub-test institution. There are weak information interaction capabilities, weak resource reuse and reorganization capabilities, and insufficient system integration. And other issues. To build a data sharing center and give full play to the role of test data resources as a strategic resource and core resource for improving equipment construction development has become an inevitable trend to further promote the informatization construction of test institutions.

2. Blackboard model
The first paragraph after a heading is not indented. The blackboard model structure is to solve the parallel and distributed computing model in which multiple entities are distributed in different physical environments to complete tasks collaboratively [4-5]. The concept of blackboard structure was first proposed by A. Newwell in 1962. Its basic idea is that the blackboard is an operating space
for solving problems, and the problems on the blackboard require the cooperation of multiple experts to solve them, and all experts can observe the blackboard. When the problem to be solved and the data needed for the solution process are presented on the blackboard, the solution work officially begins. At this time, all experts use the observation blackboard to find opportunities to use their skills and knowledge to solve the problem. When an expert finds that he can use his skills and knowledge to solve the problem on the blackboard based on the existing information, he will write down his solution on the blackboard. The expert's solution content will be "observed" by other experts as newly added information, and other experts may continue to complete the solution through the newly added information. Repeat this process until the problem to be solved is solved and the result is obtained.

The blackboard model usually consists of three parts: blackboard, knowledge source, and control mechanism, as shown in Figure 1.

![Figure 1. Block diagram of blackboard model.](image)

2.1. The blackboard
The blackboard is a dynamic database used to store data, transfer information and processing methods, and is a global work area in the system. It consists of many parts, including input data, control data, partial solutions, final solutions, and alternatives. Its function is to analyze the original data and various results produced by the system during operation (such as intermediate results and final results). We can divide the blackboard into multiple hierarchical structures, i.e., split into multiple sub-blackboards. In the process of dividing, the node template of each sub-blackboard must be determined in advance, but an instance of the node can be dynamically created. Strictly speaking, the blackboard is a working space about the problem-solving model. There are three requirements for the blackboard system: first, for the conceptual design of the blackboard, it is necessary to determine the different state changes that need to be recorded on the blackboard and how to divide the data; second, for the blackboard model system to determine whether it is dynamic or static it can be reconstructed; third, the knowledge source and its representation method must be determined.
2.2. The knowledge source

The knowledge source is a knowledge base that describes the knowledge of an independent domain problem and its knowledge processing methods. There are multiple knowledge sources in the system, and each knowledge source can be used to complete some specific problem-solving functions. Knowledge sources are stored separately and independent of each other. They communicate through the blackboard and cooperate to find solutions to problems. Experts can also be called knowledge sources. These experts are independent of each other and are divided into application fields according to their different professional skills and knowledge. Obviously, there is more than one knowledge source in each blackboard model system. When the problem-solving process requires some specific problem-solving function, it will be completed by the corresponding knowledge source. Since all knowledge sources are independent of each other, the blackboard is the only way for them to communicate and call each other. Providing corresponding information for problem solving is the goal of every knowledge source. It is composed of two parts: condition and action. It is usually called condition-action form, which can be expressed as rule set, process or logical proposition. In the condition-action form, the condition describes the premise of the application and solution of the knowledge source, and the action describes the behavior of the knowledge source. In the process of solving, when the conditions are met, the system will trigger the knowledge source and execute the action part. The action part forms a new state by adding or modifying the content on the blackboard.

2.3. The control mechanism

The control mechanism is the reasoning mechanism for the blackboard model to solve the problem, which is composed of a supervisory program and a dispatcher. The supervisory program activates related knowledge sources according to the state changes of the blackboard, and puts the executable knowledge sources of the action part into the dispatch queue. The scheduler selects the most appropriate knowledge source to execute, and uses the results of the execution to modify the state of the blackboard to create conditions for the next inference loop. The most complicated task of building a blackboard model system is to complete the design of its monitoring mechanism, because of its too much variability. In the monitoring organization, the monitoring program completes the activation operation of the relevant knowledge source according to the changes on the blackboard, and transfers it to the dispatch queue. Then the dispatcher will select the appropriate knowledge source to solve the problem on the blackboard, according to its solution results modify the state of the blackboard to create conditions for the next solution.

3. Data sharing strategy

As an efficient and universal data storage and processing tool, the blackboard structure shows certain advantages in large-capacity data processing. In the distribution and sharing of big data, each test data storage node can be regarded as a knowledge source, which stores different types of test data. The blackboard is the global data sharing library, and each data node coordinates the data sharing through a certain control mechanism. The library is updated.

Test data is usually collected by multiple test units according to their functions and stored in their respective data storage devices (data storage nodes). Refer to the blackboard model to establish a data sharing model consisting of the data management service center, each data storage node, and distribution sharing mechanism. The data management service center, each data storage node, and distribution sharing mechanism correspond to the blackboard, knowledge source, and the control mechanism separately.

Each data storage node regularly or irregularly releases the new test data product catalogue of this node to the data management service center. When the test data requester registers the subject information, it needs through the data management service center, the data management service center will request the information Match with the data product catalog reported by each data storage node. If the match is successful, the data management service center will review the subscription qualification of the data demander. If the subscription conditions are met, the test data of the corresponding data
storage node will be extracted and sent to the data. The demander sends the data, and the architecture of the model is shown in Figure 2.

![Data sharing system model](image)

**Figure 2.** Data sharing system model.

In actual applications, the scale of the data sharing system depends on the number of users. If the number of users is not particularly large, a server's data sharing system is used; if the number of users is relatively large, multiple servers is used to work at the same time. The data management service center is responsible for receiving and matching corresponding messages and subscription conditions and completing the distribution of data.

The data storage node is responsible for publishing the data of the data source. Each data storage node manages multiple data sources. It publishes the product catalog describing the data source to the data management service center, and updates and publishes the catalog according to the reading authority on the platform system established by the data management service center for data users. The data demander is responsible for receiving the data released by the data management service center. The data storage node can not only modify the published data product catalog, but also serve as other data demanders to submit data subscription requirements to the data management service center. As a bridge between data storage nodes and data demanders, the data management service center is responsible for transmitting the data published by data storage nodes to subscribers. The data management service center provides data cache, is responsible for temporarily storing the data passed by the data storage node into the distribution database, distributes the data to the corresponding data demander server according to a certain strategy, and is responsible for maintaining the distribution server.

### 4. Operating mechanism of data sharing model

The data sharing model includes the data management center database and several node source databases (colleges, research institutes, bases, and qualified test institutions that undertake the test tasks). The model is shown in Figure 3. The data management center database that appears as a blackboard is connected to each data storage node (node source database) through a shared interface to achieve data acquisition and extraction. The data management center extracts data from different nodes and expands the database resources of the data management center. The node database obtains the database resources of the data management center according to the authority, realizes the distributed storage of shared data, and forms a centralized management. The data management center and each node regularly or irregularly release data catalogs and data products. After the data management center and each node receive the subscription data, they will store the subscription data in their respective data sources through the shared data manager and after authorization review; data; The
management center and each node import test collection data, support data, etc. from the local as required; the data management center and each node regularly or irregularly update the data catalog and data products, and publish to other databases after passing the audit, and update and run iteratively.

![Data distribution and sharing model](image)

**Figure 3.** Data distribution and sharing model.

5. **Conclusions**

Based on the blackboard model, this paper proposes a test data sharing method, integrates the data management service center and test data demanders, realizing the distributed storage, unified management and application of test data, maximizing the value of test data as a core resource, and contributing to the construction and provides decision-making support of development of test institutions, effectively transforming data advantages into decision-making advantages and action advantages, and comprehensively enhancing the service value of experimental data resources.

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