ORIGINAL ARTICLE

Research on Integrated Planning of Equipment Support Simulation Training System

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***Abstract**:* The equipment training simulation training system is an important technical means to train the combat support ability. The current equipment security training system has many defects, such as distribution, heterogeneous, decentralized, and cannot meet the actual combat state of the integrated training requirements. In an information platform, the integration of existing subsystems become an urgent need to solve the problem. The development of information systems technology makes it possible to build this unified platform. This paper uses the construction of equipment support simulation training platform as an example to discuss the construction of collaborative operation environment, the component operation of platform resources, the digital management of platform and the dynamic construction of platform, and give the corresponding solutions.

Key words: Simulation training system; Platform interconnection; Componentization; Dynamic

Introduction

Equipment support system simulation training is an important technical means in military training and plays an irreplaceable role[1]. The existing training system is developed in the process of information technology development. Due to the deepening and refinement of training needs, there are many places in the existing system that need to be improved, such as distributed in different units, hardware and software, and independent operation. With the application of information system in military training, the establishment of various training systems based on information system has become a consensus close to practical training. The current system cannot be in accordance with the needs of training tasks to achieve online operation. Therefore, the integration of multiple systems on an information platform, simulation of combat environment, comprehensive training, improve training efficiency and effectiveness have become urgent needs to solve the problem.

This paper uses the construction of equipment support simulation training platform as an example, discusses the

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construction of collaborative operation environment, the component operation of platform resources, the digital management of platform and the dynamic construction of platform, and gives the corresponding solutions.

1. Collaborative runtime environment

Due to the limitation of the existing technical conditions, the existing equipment support simulation training platform is distributed, heterogeneous and decentralized, and the construction conditions are not unified. The realization of the online system according to the training task needs becomes the key problem that needs to be solved. Analysis can rely on high-level architecture (HLA) and building of collaborative operating environment (COE), so that it has the federal operation and management[2], information exchange management and training to promote management functions, so as to complete the interaction between members of the federal. The distribution, heterogeneous and scattering of the platform are also the problems.

1.2 Federal Operations Management

The main function is to create a federation, join the federation, request pause, request save, request recovery, exit federation, and delete federated instances.

The basic process of implementation is: by the master platform in the COE to create a federation, and then the sub-platform and COE to establish a connection, according to the Federal logo application to join the Federation, as a federal member. Once the federation has been operational, federated members can request pauses, request saves, and request recovery based on federal operations. Once the federal members complete the training mission, they can withdraw from the federation at any time, and the last member of the federation is responsible for removing the federation in the COE.

1.3 Information Interaction Management

Information interaction management is completed by two links: establishing a transmission path for information between federates; sending and receiving messages between federates[3].

A transmission path for information between federates is established by the federal members to the COE statement to produce information, and to the COE order the required information. COE members of the federal members generate and order information to match the calculation of information transmission path, and the formation of information release ordering mechanism to ensure that the information Accurate transmission. The implementation mechanism is that each federated member establishes two logical areas for publishing and ordering, and the release area provides the information needed by other members, and the subscription area provides the information needed by the member.

The process of sending and receiving messages between federated members is: COE creates a message sending queue and a message receiving queue for each federated member, where the message sending queue serves to store the messages that the member needs to send when the member performs the current operation. The message receiving queue is logically composed of the real-time scheduling queue and the delay scheduling queue, executes the message receiving function, receives the message sent from the other members, and sends the message to the original message, and sends the message to the message queue. Unpacking, storing the messages in the corresponding queues, and submitting all the messages in the two queues that satisfy the condition to the member. When the federation member needs to send the message, the message is stored in the message sending queue. The COE adopts the message transmission mode to transmit the message from the message sending queue to the message receiving queue of other federated members to complete the message transmission. When the message receiving queue has message, COE uses a certain message scheduling strategy, the message delivered to the federal members to complete the message to receive.

2. Platform resources of the digital management

In order to make the correct choice of platform resource components, it is necessary to standardize its training ability, and establish platform resource component library to store and manage the coding results, so as to facilitate the rapid dynamic construction of platform resource components [5-6].

3. Attribute encoding

In order to reasonably identify, query and build platform resource components and be able to manage using tools such as computers, they need to encode these platform resource components and follow the principles of uniqueness, applicability, reasonableness, simplicity, convenience and extensibility.

Equipment support simulation training sub-platform types, the number is limited, it can be a relatively simple linear coding method, the establishment of two-tier structure of the code: First, the establishment of the platform's unique name code, which is shaped like "XXXX-XX". The properties of the platform are encoded and concatenated with the name code to form the final encoding.

3.1 Platform name code

Platform name coding is a unique identifier for platform resource components that is used to distinguish it from other platform components.

a. The number 1 to 9 on the first digit indicates the function type number. Such as 1 on behalf of equipment maintenance, 2 on behalf of the supply of equipment; 3 on behalf of ammunition supply, 4 on behalf of equipment and so on.

b. The second bit with the number 1 to 9 that equipment class code. Such as 1 on behalf of the artillery, 2 on behalf of the radar, 3 on behalf of the allegation system, 4 on behalf of the missile control device.

c. The third with the number 1 to 9 that equipment in the class code. For example, the radar in the class, 1 on behalf of the air alert radar, 2 on behalf of the artillery detective radar, 3 on behalf of gun sight radar, 4 on behalf of weather radar.

d. The fourth with the number 1 to 9 that equipment type code.

e. The fifth and sixth with the number 01 to 99 that the platform component serial number. Such as 01 on behalf of No. 1 platform, 02 on behalf of platform 2 and so on.

For example: "a type of radar maintenance simulation training platform No. 56" can be encoded as "X23456".

3.2 Platform attribute encoding

As the training staff only know the training content, standards and requirements, it is impossible for the system developers to understand the composition of the sub-platform structure and operating mechanism, in the choice of platform resource components, usually only consider the performance of the platform to support the training capacity. So, the description of the sub-platform attributes should be from the perspective of training capacity, usually including the platform to complete the training tasks, such as combat confrontation[7], security command, professional skills; platform can carry out the training tense, including The platform can support the training level, such as individual training, and collaborative training; platform for training objects; capacity standards, such as the completion of different time limits within the protection tasks.

From these analyses, we can see that the general formal description of the platform's attribute description is:

P = {Name, Function, Tense, Level, Manner, Operation, Trainer, Ability}

P-platform resource components;

Name - platform resource component name;

Function - Basic functions;
Tense-tense;
Level - Training Level;
Manner - use;
Operation - to achieve operation;
Trainer - Applicable object;
Ability - Ability.
According to the description of the platform attributes, the establishment of the general sense of the platform attribute code is shown in Table 1.

Table 1. An radar maintain simulation training platform attribute code

Encoding	Training Temporal	Training level	Usage	Completed Operation	Target User	Competency Standard
111111	Usual	Repair camp	Individual training	Maintenance	Officer	Complete T1 hours of maintenance tasks
112222	Usual	Repair Camp	Collaborative Training	Detection Repair	Noncommissioned Officer	Complete the T2 hours of maintenance tasks
…	…	…	...	…	…	…

4. Platform of the dynamic construction

The dynamic construction of the platform is to select the correct platform resource component from the platform resource component library and dynamically generate the specific training platform according to the functional requirements of the training task.
Through the analysis of the training platform construction process can be seen, dynamic construction requires three types of protection: First, resource selection, according to the needs of training tasks from the platform resource component library to select the correct resources; Second, the distribution of resources, according to the trainees, training the task content, the platform resource components distributed to the correct training terminal; third is the platform generation, so that the training terminal can be acquired platform resource components assembled into a dedicated training terminal.
The resource selection is used to select the correct platform resource component from the platform resource component library, as shown in Figure 1.

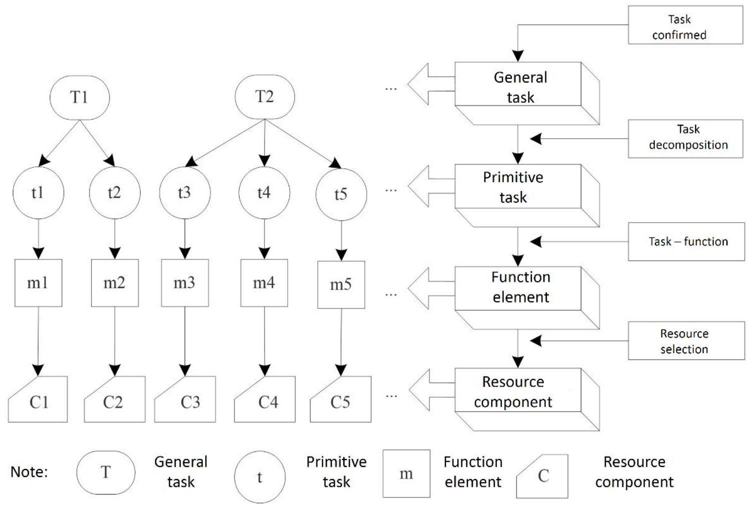

Figure 1 Resource selection mechanism

The resource selection is done in four steps, namely task requirement analysis, task decomposition, "primitive task-function element" mapping, and resource component selection.

4.1 Mission requirements analysis

Different training levels, different training objects, the training tasks are not the same, but need and training objects bear the same task. From this point of view, equipment support training tasks can be divided into equipment command and training tasks, equipment maintenance training tasks, material supply training tasks and other training tasks.

4.2 Task decomposition

The training task is obtained through the task demand analysis is macroscopic, general and cannot be directly executed by the training platform, and further decomposition is needed to realize the deepening and concretization of the training task. Task decomposition can be divided according to the training phase, but also by the main commitment to the task of division and by the object attributes to be divided. The decomposition method needs to be based on training personnel training intentions and training characteristics of the object.

The task of training task determines the task decomposition has a hierarchical feature. In the process of decomposition, the training task can be decomposed into a series of sub-tasks, and each sub-task can be decomposed into several low-level sub-tasks. Therefore, the task decomposition is level by level, from top to bottom layer by layer decomposition, the establishment of the system task decomposition of the "task tree" from the bottom of the basic task (Figure 2).

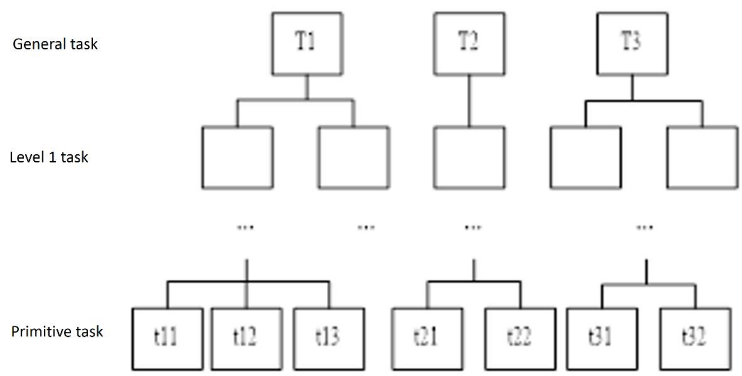

Figure 2 Task decomposition process

The characteristics of the primitive task are as follows:

a. The principle of completeness. The primitive task set should include the entire contents of the training task.

b. The principle of independence. There is no relationship, subordinate relationship, or upper and lower relationship between primitive tasks;

c. Minimize the principle. Each primitive task can be done through a limited number of safeguards activities.

4.3 “Primitive task-functional element” mapping

The functional element is the smallest functional unit that the training platform must have to complete the training task. The mapping of the primitive task to the functional element is actually the conversion of the task indicator to the functional index (Figure 3). According to the mapping relationship, we can get the set of functional elements provided by the training platform.

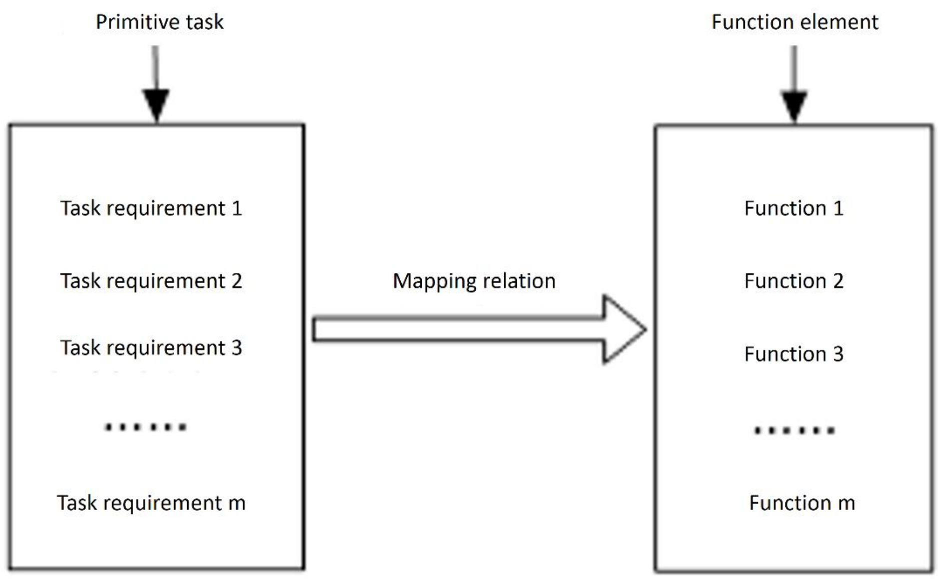

Figure 3 Mapping of “Element task-function element”

5. Discussion and Prospect

This paper explores the interconnection principle of the sub-platform involved in the integration of equipment support training system, and provides a feasible technical way for the sub-platform access to the simulation training system. The principle has been applied to the design of a simulation training system.

The implementation plan of the equipment support simulation training system is a system engineering[8]. Each subsystem constitutes a complex network, which forms a larger network through system integration[9]. The system also covers energy and power security systems, information collection and processing systems, equipment maintenance and personnel management systems, and as a sub-network will be incorporated into the entire military activities to collaborate to form networks[10] and super-network[11]. Complex network theory provides a powerful theoretical framework and method to describe the structure of this system and its relationship with dynamic processes, and to study the robustness, optimization and control of the structure[12]. This is one of our next research directions.

At the same time, the completion of this integrated system will provide us with a large amount of equipment support training data, the use of large data analysis technology can be a comprehensive and quantitative evaluation of the training effect[13-15]. The tactics of the existence of tactics problem can be analyzed in further research to provide improvement strategy recommendations.

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