

Design of Information and Communication Wargaming System

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Abstract

Information and communication is the core to win the war in the information age, and is important guarantees for our signal troops at war. Wargaming as a tool for simulating war is widely used in joint operations and areas of expertise. Compared with the US military, our military is seriously lagging behind in the field of information communication wargame. Through studying the basic elements and system functions of the information and communication wargame system, this paper proposes the chess pieces, rules and system function design of information and communication wargame, and makes a preliminary exploration in professional field design of military wargame, and fills the gap in the information and communication military wargame of our army. This lays a certain foundation for the combat methods, the evaluation of the support scheme, and the education and the training of the information and communication field of our army.

Keywords

Information Communication; Wargaming; Basic Elements; Chess Pieces; Rule.

1. Introduction

With the substantial increase in the degree of dependence of war fighters and weaponry on information, the leading and controlling role of information flow in operations has become increasingly evident. The right to control information has become the focus of the rivalry. Information system equipment has become the preferred target of both sides. The combat command and confrontation of the information and communication forces have also moved from the "backstage" to the "front stage", disrupting the orderly flow of information flow has become a key measure for the opposing sides to win the confrontation.

As an effective tool for simulating actual combat, wargame is highly valued by major military powers in the world, and have been widely used in combat theory, combat plan evaluation, and combat decision-making. In recent years, our army has vigorously promoted the research and development of computer wargame systems, computer wargame has developed to a certain scale, and the joint combat wargame system has been further developed and improved. But in general, the research on wargame in our army is still in its initial stage, especially in the field of information and communication, wargaming is almost blank.

Build an information and communication wargame system, through information and communication wargame deductions, under the approximate real combat background, relying on the real process of system confrontation, force application and ability to implement. It has great significance to test the operational capability, evaluate the operational effectiveness and study the system combat program of our army's information communication equipment.

1.1 Origin

The concept of using wargame to deduce the progress of war and calculating the gains and losses of war has existed many years. During the Warring States Period(475-221 B.C.), our country's famous military strategist Mozi "dissolved the belt into a city and used the certificate as a weapon", and successfully made the King of Chu realize the loss of the siege and prevented he attacking the Song Dynasty ((960-1279B.C.); Baron Von Reisswitz invented "Kriggs Bell" based on traditional chess, which is a simulation wargame [1]. Then in 1995, the first electronic wargaming system JTLS [2] was launched by the US military, and wargaming played more and more important role in warfare.

Many historical facts show that the war process simulated by scientific wargaming is highly consistent with the actual war, but wargaming that ignore important factors are often very different from the results, and will inevitably bring painful lessons. For example, during World War II, the Japanese navy used wargaming to raid Pearl Harbor, and the results showed that the plan was feasible, so they risked sea storms avoiding the surveillance of the U.S. military then successfully raiding Pearl Harbor, which caused heavy losses to the U.S. military; German army organized three huge-scale command post wargaming code-named "Operation Otto", before attacking Soviet Union, but due to the neglect of the Soviet Union's mobilization ability and the cold winter, the German army suffered a historical defeat in the Soviet Union. Wargame originates from war and serves war, developing a scientific wargame system that has great significance for making correct war decisions, improving combat plans and winning the war [3].

After the middle of the 20th century, with the rapid development of computer modeling and simulation technology, the development of computer wargame technology has become increasingly mature, and due to its powerful computing power, storage capacity and good interactivity, the flexibility of computer wargame has been greatly enhanced, and it is easier for users to operate, so computer wargame gradually replaced manual wargame and became the mainstream direction of wargaming [4].

1.2 Concept

Wargame is a tool for simulating and adjudicating game activities of two or more parties by using maps and chess pieces that visualize the battlefield environment and military strength, mainly based on rules (data) formed by statistical analysis of military practice experience, and supplemented by models. By simulating the real battlefield environment, military operations, and decision-making confrontation, wargame has become an important measure of simulating, analyzing, and researching war. It consists of chess pieces, chessboard (map), rules, scenarios (combat background), data and other elements. The key core elements in the design are chess pieces, chessboard and rules. [5].

1.3 Classification

Through the deduction form, purpose and use, we can classify the wargame. According to the constraints of the action and the basis for ruling, it can be divided into strict wargame and free style wargame. According to the basic carrier and technical measures, it can be divided into manual wargame and computer wargame. According to the level and level of command and application, it can be divided into strategic wargame, campaign wargame and tactical wargame. According to the main application and purpose of use, it can be divided into training wargame, inspection wargame and entertainment wargame. [6].

2. Research Status

2.1 Current Status of Foreign Research

At present, the world's major military powers have established specialized wargame research institutions, and have successively developed and applied a large number of computer wargame systems. Among them, the computer wargame system developed by the US military is the most comprehensive, mature and advanced. The U.S. military's joint theater level simulation (JTLS) is a large-scale wargame system that supports land, sea, and air multi-service joint operations. The system

mainly adopts a Web-enabled architecture and can achieve distributed sites deployment and operation. JTLS is mainly composed of scenario preparation tools, system creation, initialization program, Web service, participant interface program based on Web host, scenario support tool, and combat event program module, realizing scenario editing, action deduction, simulation and results of wargaming, which is a typical joint combat deduction wargame.

There are many similar U.S. combat wargame systems, such as the joint semi-automatic force [7], the Army's new generation computer generated system [8], the naval simulation system [9], and the flexible analysis modeling and exercise system [10], etc. With the help of these wargaming systems the U.S. military has shown absolute superiority in foreign wars in recent decades. However, for the construction of the communication network system of the information and communication force, there are very few wargame in which the deduction, accusation and command messages and reconnaissance intelligence messages are transmitted in the network system.

The U.S. Army's Extended Air Defense Simulation (EADSIM) [11] has precise requirements for response time and target information acquisition in air defense simulation operations, and its system describes the communication model in great detail. The communication model of the system mainly includes network model, message model and equipment model. Finely describe the generation, sending, transmission, and reception of air defense messages, and model the frequency bands and network protocols used by communication equipment, as well as the bandwidth, power, signal-to-noise ratio, delay, and backup of equipment transmission, which can describe the propagation loss, time and shielding of radio in the digital terrain environment. That achieves the deduction calculation of the communication response time of the air defense system and the acquisition of air defense information through communication, but the deduction of the construction of the information communication force network system has not been realized.

2.2 Research State in China

Our country's research on wargame started relatively late, but it has also made some progress. Yang Nanzheng published "Wargame War Game Simulation "[12], which made a detailed study and discussion of wargame and related theories.

The National Defense University built the first large-scale campaign wargame confrontation deduction system in the whole army. The system can realistically simulate various operations such as land combat, naval combat, air combat, and special operations, which has strong support capabilities. [13].

The National Wargaming Competition hosted by the Chinese Society of Command and Control uses the Mozi Future Commander Wargaming System developed by Beijing Huashu Protection Technology Co., Ltd. The system has rich assumptions about the basic situation, combat intentions and combat development of both sides of the battle, covering land, sea, air, space, and electricity joint operations, which can provide campaign and tactical level deductions, providing more than 130 major countries or regions equipment, force deployment and operational rules data. The other competition uses the "Iron Armored Assault Group" wargame deduction system of Jinan Chess Battle. The system pioneered wargame AI and successfully supported more than 600 contestants to compete with AI online on the Internet, demonstrating the rapid progress and broad prospects of artificial intelligence technology in wargaming strategy confrontation. [14].

3. Basic Elements of Information and Communication Wargame

Information and communication wargame is essentially a combat simulation method that uses quantitative analysis methods to study and analyze information and communication support issues, which purpose is to simulate information and communication support operations according to known or assumed situations and data. Including the simulation of many factors such as combat time, geographic space, information and communication support force deployment, station status, action process, communication effect, and battlefield contingency events. Finally, it is necessary to give not

only the adjudication result of the information and communication support operation, but also the adjudication result of the impact of the operation on the joint combat operation, so that can achieve the goals of personnel training, research on tactics, and evaluation of plans.

For the design of information and communication wargame, firstly we must realize the basic elements of information and communication wargame. There are different understandings of the components of a wargame system. However, essentially the core elements of war chess mainly include three elements: chess pieces, maps, and rules.

3.1 Chess Pieces

In wargame, chess pieces are mainly divided into two categories. The first type is military chess pieces, which can represent different levels of combat power or weapons and equipment. The other type is annotated chess pieces, also known as "event chess pieces", which are used to record dynamic battlefield situations such as casualties, damage, and emergencies on the battlefield. The joint combat wargame is mainly the deduction and adjudication of firepower operations, so the military chess pieces used have clear attributes, mainly related to firepower operations, such as mobility, attack power, attack range, and defense power. For information and communication wargame, it should not only pay attention to firepower operations, but also the network relationship of information and communication forces.

3.1.1 Pawn Chess Pieces

Pawn chess pieces are combined with the actual combat training. In the wargame system, the forces of unified activities such as network nodes, support forces and blue army equipment are used as chess pieces. The information and communication pieces can be constructed in the form of "piece shell + equipment". During the planning stage, the players will load the corresponding equipment according to the information and communication support plan to form the chess pieces required for this game. Communication network node pieces = loading platform + communication device 1 + communication device 2 +... + communication device n. Guaranteed strength piece = communication network node piece 1 + communication network node piece 2 +... + communication network node piece n. Blue chess pieces = loading platform + reconnaissance equipment/jamming equipment/damaging weapon. That is set the communication node pieces are loaded with fixed communication equipment according to the actual situation, which are special pieces and need to be pre-assembled.

3.1.2 Marked Chess Pieces

Annotating chess pieces is to mark the states and results that cannot be marked on the front of the military chess pieces, and it has the function of auxiliary display. For a piece of combined forces, if it is destroyed or damaged after being attacked, a marked piece with "destroyed" or "damaged" can be stamped on the piece, indicating that the piece is destroyed or damaged; For information and communication wargame also has a state of being disturbed in combat operations, so the types of marked pieces should be more abundant according to the actual combat state of information communication.

3.2 Checkerboard

The chessboard (map) is an abstraction and simulation of the combat space, which is the result of the quantification of the battlefield geographic environment data. The chessboard of information and communication wargames should be able to fully reflect and demonstrate the characteristics of information and communication confrontation, and meet the common needs of information and communication professional wargame and joint combat wargame respectively. It is mainly divided into three aspects: the quantification of wargame maps, the deployment of information and communication forces, and the display of information and communication operations.

3.2.1 Wargame Map Quantification

In order to be integrated into joint wargaming, the information communication wargame map should adopt the same quantification method as the joint wargame map, which adopts the general six-point

grid processing method [15], in the expression form and color of landmark terrain features that must be aligned with the joint wargame to facilitate integration into the joint wargaming. In addition, the influence of terrain and features on communication should be considered on the basis of the joint combat chessboard. For example, high-voltage lines will interfere with communication links, metal mines will also interfere with electromagnetic signals, etc. Therefore, special attention should be paid to marking on the map. Identify all kinds of terrain and features that affect information communication.

3.2.2 Information and Communication Force Deployment

In the deployment of information and communication forces, in addition to the joint combat background, a layer needs to be added to the information and communication wargame map for the deployment of information and communication pieces, which each piece is in the hexagonal grid of the wargame map. Since multiple pieces of equipment are usually deployed in a communication node at the same time, it is necessary to superimpose and arrange multiple pieces in the same map grid. There are strict requirements for the deployment process and deployment positions of information and communication pieces, that is, they are subject to the mandatory constraints of the layout rules of this type of information and communication equipment. For example, short-wave radio vehicles with high transmission power and easy detection by enemy radar must be more than 3km away from the command post.

3.2.3 Information and Communication Operational Display

In the information and communication operations during the wargaming, it is necessary to be able to simulate the information and communication operation process on the information and communication wargame map, and visually show the information and communication operations to the information and communication commanders. For example, if a trunk node vehicle needs to move on land in a certain round, it is necessary to automatically display the dynamic process of the chess piece moving one by one on the war chess map; When a trunk node establishes a microwave link with another trunk node, a dynamic solid line should be used to connect the two nodes, and the connecting process of the two nodes should be visually displayed.

3.3 Rules

The rules of information and communication wargame are the core elements of information and communication countermeasure wargame. They are quantitative description of the impact on information and communication network systems by combining information and communication practices and analyzing the physical environment, electromagnetic environment and information and communication actions of the battlefield in information and communication countermeasures. Information Communication Soldiers Wargame Rules include three main categories: Layout Rules, Action Rules and Adjudication Rules.

3.3.1 Layout Rules

The rules for the layout of information and communication wargame, in addition to considering the geographical topography and area of deployment, the limitation of the number of troops, etc., but also according to the information and communication equipment installed, and the operational requirements of the joint operation supporting deployment, comprehensively consider the information and communication deployment positions and nodes. Comprehensively consider the factors that affect the efficiency of equipment use, such as information and communication deployment positions, distance between nodes, terrain shielding, high-voltage lines, etc.

3.3.2 Rules of Action

The rules of action for information and communication should first consider the operations of information and communication forces, network system construction, etc., then focus on the communication support operations for joint combat forces, and finally consider the intelligence coordination, task coordination, and action coordination with other troops.

3.3.3 Adjudication Rules

Due to the difference in the specific content of the ruling, the ruling mechanism and process in the information and communication ruling rules are different from the joint combat firepower ruling mechanism. The content of the joint combat firepower strike ruling is the lethality of firepower warfare, and the outcome can be judged according to the comparison of the power losses of the two sides, and the effect is more intuitive; and the information and communication ruling should focus on the communication support ability of the information and communication forces to our joint combat forces. Capability assessment needs to be determined based on the communication needs of joint operations, and whether the communication force meets the communication needs.

4. Information Communication Wargame System

The functional architecture of the wargame system is sorted out and refined based on the functional requirements of the system. For the information and communication support wargame system, the functional architecture of the communication wargame can be constructed according to the three basic processes of game preparation, game implementation, and game replay.

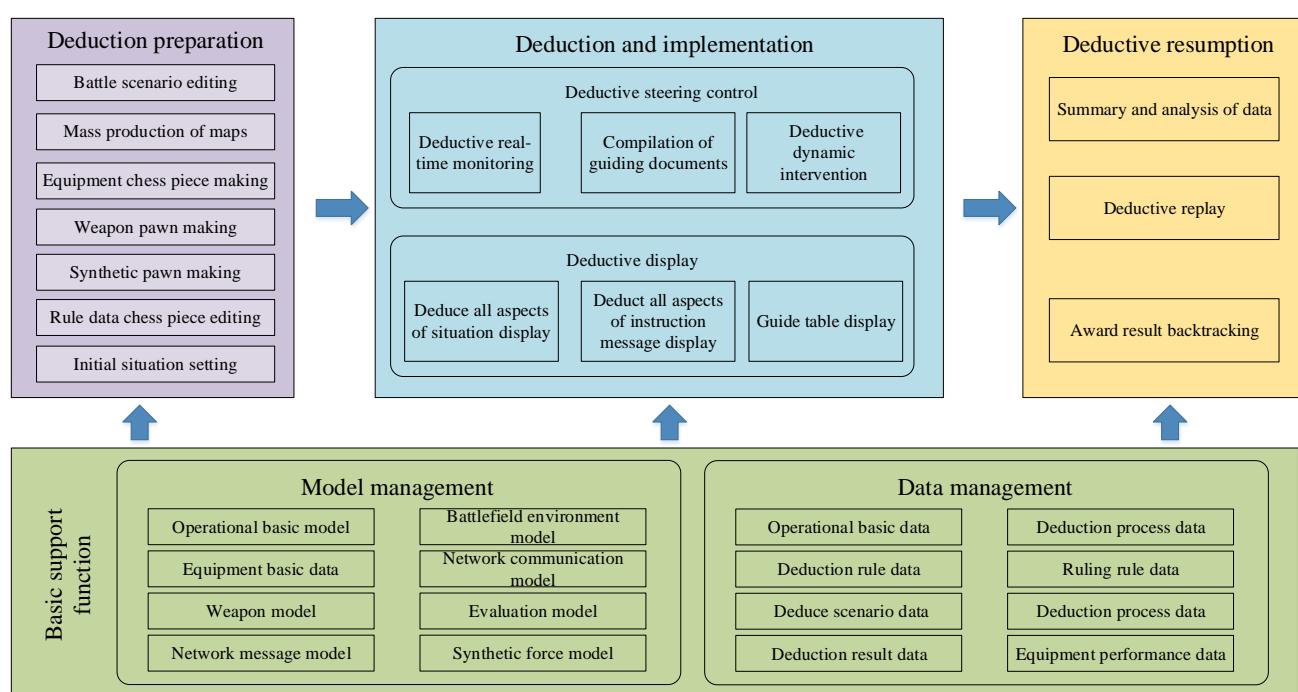


Fig.1 Communication wargame functional architecture

4.1 Game Preparation

The preparation stage of the game is mainly to prepare the relevant scenario data for the game, mainly including the map environment, combat force, communication equipment, etc., and also includes the entry and verification of various rule data.

4.2 Deduction Implementation

The deduction implementation stage mainly provides the functions of deduction director control and deduction display for the director and deduction participants. For the deduction director, it is necessary to establish and manage the deduction process within the wargame system, and conduct timely director control in the whole process of deduction. For the deduction participants, they need to be able to visually view the deduction situation and related information, and input the combat determination plan into the wargame system.

4.3 Deduction Review

The review stage of the deduction is to review and summarize the deduction after it's over, so as to provide an important quantitative analysis basis for the participants to summarize experience, refine tactics, evaluate combat plans, and optimize weapons and equipment plans. Therefore, auxiliary functions such as data summary analysis, deduction replay playback, and adjudication result retrospective must be provided in the deduction replay stage.

5. Conclusion

As an effective measure to study and simulate information security combat. Information and communication wargame plays an important role in assisting combat planning, command strategy training, research and verification of tactics, and training of command staffs.

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