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CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

11 November 1976

MEMORANDUM FOR: The Director of Central Intelligence

FROM : William W. Wells
Deputy Director for Operations

SUBJECT : USSR GENERAL STAFF ACADEMY LECTURES: Principles of the Automation and Mechanization of Troop Control

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on a collection of seven lectures, classified SECRET, prepared by the General Staff Academy for publication by the First Directorate (Operations) of the General Staff of the Armed Forces of the USSR in October 1969. This report is the English translation of a lecture dealing with current requirements for automated control systems to increase the combat readiness and capabilities of the armed forces while increasing the efficiency of control and reducing the labor expended by command personnel. The lecture provides a summary of possible areas for application of automation and an explanation of the principles of military cybernetics upon which automation is based. The employment of computers in military districts, particularly in command-staff exercises, also is examined. This lecture was prepared in 1968. The Russian text was disseminated as FIRDB-312/00033-76.

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies.

William W. Wells

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Intelligence Information Special Report

COUNTRY USSR

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SUBJECT

GENERAL STAFF ACADEMY LECTURES: Principles of the Automation and Mechanization of Troop Control

SOURCE Documentary

Summary:

The following report is the English translation of a lecture, classified SECRET, prepared in 1968 by General-Mayor of Engineer-Technical Service Anureyev and Colonel Khabarov for presentation to students of higher academy courses. This lecture deals with current requirements for automated control systems to increase the combat readiness and capabilities of the armed forces while increasing the efficiency of control and reducing the labor expended by command personnel. The lecture provides a summary of possible areas for application of automation and an explanation of the principles of military cybernetics and the nature of probability and other theories upon which automation is based. Attention also is devoted to an examination of the employment of general-purpose computers in military districts to perform staff operational and accounting functions, and particularly to the use of computers in command-staff exercises and war games.

End of Summary

Comment:

The Russian-language version of this lecture was disseminated as FIRDB-312/00033-76.

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Orders of Lenin and Suvorov Military Academy

of the General Staff of the Armed Forces of the USSR

SECRET

APPROVED

Chief of the Academy

General of the Army S. P. Ivanov

6 September 1968

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Doctor of Military Sciences, Professor,
General-Mayor of Engineer-Technical Service ANUREYEV

Doctor of Military Sciences, Assistant Professor,
Colonel KHABAROV

Principles of the Automation and Mechanization of Troop Control

Lecture for Students of Higher Academy Courses

1968

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Introduction

Military actions in a modern war will be characterized by great fluidity and mobility, broad territorial scope, and frequent and abrupt situation changes. A significantly larger number of heterogeneous forces and means will participate in operations than in the past; they will be deployed over a wide front; their actions will be distinguished by high speeds.

The strategic goals of an operation are achieved today through combined action against the enemy by all branches of the armed forces simultaneously, on land, on the sea, in the air, and in space. Victory is becoming the result of joint action against the enemy by all armed forces branches and the full might of the state.

Control of many different forms of equipment and of different armed forces branches, each with its own specific characteristics, is a difficult matter. It is practically impossible today, as distinguished from the situation in past wars, to correct errors which are allowed to occur in planning, and particularly in implementing, combat actions in which there is massed employment of missile/nuclear weapons. Therefore the question of optimizing control is especially important.

Thus, the employment of missile/nuclear weapons and other means of mass destruction, the high mobility and maneuverability of troops, and the change in the nature of present-day operations place new and demanding requirements on the system for controlling forces and means in operations on land, in the air, and on the sea. These new requirements must also be met by the respective control means of these forces.

One of the ways of producing a control system in conformity with the requirements of missile/nuclear warfare is through wide introduction of means of mechanization and automation and through creation of automated systems for various purposes. The basic concept of automating control processes at all troop command levels is to expand the creative capabilities of commanders to provide highly effective command of modern operations.

I. Current requirements imposed on the control of combat actions of the armed forces branches

The most important requirements placed on troop control are:

-- to increase the combat readiness of the armed forces;

-- to increase the efficiency of troop control;

-- to expand the combat capabilities of all armed forces branches;

-- to reduce the expenditure of labor by command personnel and control organs in order to make more time available for the creative process in troop control.

Increasing the combat readiness of the armed forces is the most important task. At the present time a large nuclear potential has been built up, enabling us, if aggressors should unleash a new world war, to employ missile/nuclear weapons of various types in practically unlimited quantities.

The concept of combat readiness embraces an extensive set of varied and complex measures. In its most general form, the essence of combat readiness can be expressed as the capability of armed forces not only to repulse a surprise attack by an aggressor, but also to deal him a crushing defeat, first and foremost with the rocket troops.

Therefore, the control of the rocket troops of all armed forces branches must be prepared to ensure the timeliness, precision, and effectiveness of missile/nuclear strikes against the most important enemy targets and the capability of all armed forces branches, including ground forces, to go into action immediately following nuclear strikes.

Control organs must carry out an enormous amount of work in processing different forms of information concerning their own and enemy forces, the terrain, the meteorological situation, etc., within extremely compressed time limits. Actual experience shows, however, that this staff function cannot be carried out with existing methods and means. The necessity of employing means of mechanization and automation is thus perfectly obvious.

The air defense system plays an important role in the combat readiness of troops. The control of air defense troops must provide for: timely detection of enemy targets; automatic guidance of surface-to-air missiles and fighter aircraft to them; rapid analysis of complex air situations; and the committing of air defense forces and means to repulse enemy missile and aircraft attacks. With the speeds now characteristic of means of air attack and defense, the effectiveness of an air defense system can be ensured only by employing the latest achievements of radioelectronics.

Of enormous significance for increasing the combat readiness of armed forces is a timely and efficient plan of mobilization measures. Massed enemy employment of means of mass destruction can lead to the putting out of operation of many installations, especially installations supporting the normal movement of mobilized contingents, equipment, and materiel reserves; this will jeopardize the fulfilment of the mobilization plan and will thus sharply lower the combat readiness of the armed forces.

The solution is to be found in the employment of means of automation making it possible (using previously prepared problems) to perform in a short time the necessary calculations for the implementation of mobilization measures in accordance with the specific situation.

Increasing the efficiency of control under modern conditions becomes particularly crucial at all levels of troop control.

The concept of control efficiency can be expressed by the following inequality:

$$T_{con} + T_{act} \leqslant T_{crit} \,,$$

where: T_{con} -- the time expended on the control cycle, i.e. for obtaining information on the position, status, and nature of troop actions (T_1), for processing this information and making a decision (T_2), and for transmitting the appropriate orders to the troops (T_3). Therefore $T_{con} = T_1 + T_2 + T_3$;

T_{act} -- the time required by forces and means to carry out orders received;

T_{crit} -- the critical period by whose expiration the carrying out of the order given will no longer lead to the anticipated and planned result because the information will have become outdated.

Therefore, the condition for control efficiency can be written thus:

$$T_{con} \leqslant T_{crit} - T_{act} \,.$$

This means that the time expended on the control cycle must not exceed the difference between T_{crit} and T_{act}. The smaller T_{con}, the more time remains for the preparation and commitment of forces and means.

Utilizing the inequality set forth above, we can determine the maximum allowable time for the control cycle.

To illustrate this a table is set forth below, showing the time (in minutes) available for the control cycle of strategic missiles when a retaliatory nuclear strike is being organized.

The time needed to launch missiles from a status of full combat readiness is taken as equal to three minutes (for type A missiles with boosted run-up of gyroscopes) and 20 minutes (for type B missiles of earlier designs).

Early warning is provided: in the first instance -- by radars, in the second -- by a space system.

Enemy missile types		Polaris A-3	Minuteman
Type A missiles	Radars	12	14
	Space System	17	30
Type B missiles	Radars	-5	-3
	Space system	0	13

It is evident from this table what an enormous effect a space early warning system has on the duration of the control cycle.

The requirement for a high level of efficiency is occasioned by the fact that, as a result of the introduction of new means of armed combat into the troops and the expansion of the scope and nature of operations, there has, on the one hand, been a sharp increase in the flow of information and the frequency of information exchange between troops and control organs, while on the other hand there has been a significant reduction in the time available for processing this information and making decisions. Time has become one of the decisive factors in the successful control of forces and means of all armed forces branches, especially the rocket forces and air defense forces.

There also has been a change in the nature of the information. For example, data on targets of nuclear strikes must not only be received rapidly but must also have greater accuracy and detail. New forms of information have appeared: on the radiation, chemical, and bacteriological situation; on enemy radioelectronic means; etc.

Continuity of troop control can be ensured only if control organs operate at a high level of efficiency. However, this means that staffs must, within limited time periods, carry out a large volume of varied calculating functions connected with the employment of missile/nuclear weapons, air defense forces and means, and means for combating enemy radioelectronic equipment; with projecting the anticipated nature and extent of destruction of troops and other targets from one's own nuclear strikes and also from those of the enemy; with assessing the radiation and chemical situation; with making complicated navigational and navigator calculations; with moving troops; with determining the balance of forces; with providing materiel and technical support; etc.

Experience from command-staff exercises and war games indicates that it takes a fairly long time to carry out all of this work manually with existing means.

One of the radical ways of sharply increasing the operating efficiency of control organs is introducing various means of automation into the staffs, this to be done in combination with further improving the working methods of the command and staffs and the organizational structure of the control organs, increasing their mobility and survivability, reducing the volume and simplifying the content of combat and operational documents, and improving the communications system and equipment.

Expanding the combat capabilities of all armed forces branches can be ensured by efficient and well-grounded planning for the employment, above all, of missile/nuclear weapons, which is possible only on the basis of analyzing different variants and choosing the most favorable one. However, when there is a critical lack of time, the preparation of several variants is possible only by employing computers to perform calculations.

To illustrate the growing combat capabilities of strategic nuclear forces, two tables are presented below characterizing the destructive properties of warheads of the megaton class and the basic flight performance and tactical data on nuclear weapons delivery vehicles.

Destructive properties of nuclear weapons

Flight performance and tactical data on delivery vehicles

Types of delivery vehicles / Data	Aerodynamic vehicles		Ballistic missiles	
	1968	Future	1968	Future
Speed, km/hr	3,500	28,800	25,000	25,000—28,800
Altitude, km	25	100	1,300	1,300
Range, km	17,000	17,000	15,000	Unlimited
Probable error, km	0.3	0.3	1.5	0.7

TS #768044
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Reducing the labor expended by the command personnel of control organs depends on the number of important requirements made on the control system. Troop control under modern conditions demands particularly flexible and precise thinking by commanders and staff officers. In order to accomplish continuous control, they must not only be informed on the current situation at all times but must also be able to foresee changes in it. This demand can be met through the use of means of automation. For this purpose it is necessary to free command personnel from the laborious and unproductive manual work of collecting and processing information and from the manual performance of a great many complicated operational-tactical calculations and numerous purely technical jobs. We must not go any farther toward increasing the number of personnel in control organs, since this would lower the mobility of staffs.

The most radical method of fulfilling this requirement is to equip control organs with high-performance, high-speed computers. This will, beyond any doubt, relieve commanders and staff officers of technical work, give them time for creative activity, and, which is very important, expand the scope of their thinking and give them the capability to examine a series of variants for the calculations and take into account a greater number of the factors affecting combat actions.

II. The essence of the automation of troop control processes

"Automation of troop control processes" is understood to mean the sum total of measures directed toward increasing the efficiency and quality of control by introducing into control organs individual high-performance technical means and integrated automated systems of general or special purpose.

The main processes to be automated are: collection of primary information; processing, formulation, reproduction, and visual display of information; performance of a set of calculations; and transmission of information.

In automating the working processes of the command and staffs, it is necessary to combine the creative mental work of commanders with the operation of various kinds of automatic equipment and other technical means. At no stage of automation of control processes does computer equipment replace the commander; rather it creates favorable conditions for him to make more soundly based decisions for the conduct of combat actions and for the maximum utilization of the capabilities of modern means of armed combat.

The equipping of control organs with means of mechanization and automation must proceed by stages. The simplest means of mechanization and automation must be introduced into the control system first of all. The most important role at this stage is played by automatic secure communications equipment for telephone conversations and telegraphic transmissions by radio, radio-relay, and wire communications channels, cipher and coding machines, signal-coding devices, sound recording equipment, and by superhigh-speed communications means and loudspeaker communications at control posts. In order to mechanize computational and other staff work, it is necessary to introduce various different computers and accessories, copying-reproducing equipment, and other equipment.

It must be noted that, because of the complexity and high combat capabilities of missiles, aviation, air defense forces and means, missile submarines, surface ships, and other modern means of waging war, automation of the processes for controlling combat means is an objective necessity in such armed forces branches as the rocket forces, the air defense forces, the air forces, and the navy, and has already been firmly adopted into the operating practice of control organs. In the air defense forces, not only is a fully automated system functioning successfully within individual surface-to-air guided missile systems, fighter aircraft, and radiotechnical troops, but entire air defense units and large units have been equipped with automated control systems.

Similar automated systems are in wide use in surface-to-air missile units, the air forces, and the navy.

Thus, automated control of combat means is becoming the usual method of control. This is because the processes of controlling the means of waging war lend themselves relatively easily to formalization, since the factors determining the essence of the processes can, as a rule, be expressed numerically (speed, altitude, weight, electrical impulses, capacities, coordinates, etc.).

It is a much more complicated matter to automate the operating processes of the staffs of formations and large units. Here we encounter a great many connections and interdependencies among branch arms and services, among different troop command levels, among directorates and departments within staffs, etc.

The nature of these connections is very complex and very difficult to formalize. The human being plays one of the main roles here. It is therefore necessary to determine to what degree and in what form automation is possible and to identify a reasonable distribution of functions within the overall "man-machine" scheme. This is a large and complicated task, whose fulfilment is an objective necessity.

It is for precisely this reason that the setting up of integrated automated systems must be preceded by a phase of acquiring experience in the use of simpler means of automation, of training generals and officers to operate under conditions of a high level of technical equipping of staffs, and also of improving algorithms for various problems.

Any automated system will comprise three basic components: data sensors for primary information, electronic computers for various purposes (with a set of display components and other auxiliary technical components), and high-speed communications means. There will of course also be different degrees of technical equipping of the system, depending on the purpose.

The automated system of the General Staff and of the main staffs of the branches of the armed forces is the supreme operational-strategic and technical level in an integrated automated system of control of the armed forces. It is intended to provide for the mechanization and automation of the main operating processes of the General Staff and the main staffs of the branches of the armed forces involved in strategic planning and command of armed combat and also in the building of the armed forces.

This system must also be connected with the systems of the General Staffs of the armies of the Warsaw Pact countries.

Automated systems of fronts are intended to ensure a high level of efficiency in the command of all the troops of a front and to provide for the most effective employment in an operation of the various different means of waging war. The systems include: multipurpose, small-size, reliable, transportable electronic computers; special electronic computers for controlling the rocket troops and artillery and the air defense forces and means of the front, and the rear; automated systems of the combined-arms armies, tank armies, and the air army, and of large units of front subordination; and integrated sensors for the information of special reconnaissance units and organs of the front.

The automated system of a front must be coupled with the automated systems of the General Staff, of adjacent fronts, of formations of the Air Defense of the Country operating in the front's zone, and of the staffs of other cooperating formations and large units.

The main element of the automated system of a front is the combined-arms automated system, which comprises all control organs from the battalion up to the front field headquarters. With this system are coupled the specialized systems for controlling the rocket troops and artillery, the air defense forces and means, and the large units and units of the air army, as well as the system for controlling the front (army) rear.

Other special-purpose automated systems also have a similar structure (those of the strategic rocket forces, the air defense of the country, long range and military transport aviation, flight control, control of the naval forces and means, the Staff of the Rear of the Soviet Army and Navy, and the rear staffs of fronts and fleets).

The development of such automated systems represents a complicated task, in many instances requiring a new, efficient approach to the essence of an automated control process, original engineering decisions, the production of new technical equipment or the establishment of new principles of integrating existing equipment, etc. All of this, naturally, requires time and substantial material resources.

III. Military cybernetics -- the theoretical basis for the automation of troop control

The theoretical basis for automating control processes is provided by a new branch of knowledge -- cybernetics.

Cybernetics is the science of effecting optimal control of complex dynamic processes in all realms of human activity and of the operation of various mechanisms. Exploiting the achievements of many sciences, first and foremost mathematical research methods and statistical and logical analyses, cybernetics determines the general laws inherent in control systems of various degrees of complexity and on the basis of these laws works out recommendations for automating control in each specific field, including military affairs.

The specificity of the various fields of human activity have caused a branching off from cybernetics, as the science dealing with the general laws of the processes of control and the transmission of information in different systems, of a series of new directions. Thus, today we can speak of military cybernetics, technical cybernetics, medical cybernetics, etc.

Military cybernetics deals with questions of the functioning and optimization of the complex systems intended to control troops and combat means.

The following are the basic subdivisions of military cybernetics which are used in working out the theoretical bases for automation of troop control processes:

-- theory of military information, which deals with questions of the conversion, transmission, and storage of information circulating within a control system;

-- theory of algorithms, which deals with methods of converting and processing information in electronic computers;

-- theory of control systems, which deals with questions and conditions of the functioning of various different control systems, the principles and structure according to which they are set up, and the technical means which they require.

The theory of military information deals with two basic problems: the most productive utilization of communications channels for information transmission and the methods of information conversion (coding) and storage in the electronic computers and other devices of the various control organs. In automated control systems for various purposes, the speed of information transmission over communications channels is of decisive importance, as is -- and this is very important -- the reliability of the information being transmitted.

The speed of communications is the speed of passage of information within a communications system. It is inversely proportional to the time required for passage of one message through the system. Therefore the acceleration of data transmission will depend above all on the reduction of its volume, since it is a complex technical problem to increase the capacity of the channels.

By way of illustration, the following table is set forth, indicating the approximate volume of information to be processed within staffs (in a 24-hour period).

Staff	Army	Front
24-hour volume of information, in characters	300,000	1,000,000

The volume of information transmitted can be reduced by condensing and standardizing. This approach is entirely feasible, since the experience of many command-staff exercises shows that the content of existing documents suffers from considerable redundancy.

"Reliability of communications" is understood to mean uninterrupted operation of communications channels. Finding methods to increase the reliability of communications is one of the important tasks of the theory of military information.

Reliability of transmission is the absence of distortion in the information transmitted over communications channels. Increasing the reliability of information transmission by all possible means is particularly important for automated control systems, since electronic computers can correctly process only information of adequate reliability.

The theory of military information is used to develop various different methods and technical equipment to increase reliability of transmission of messages over communications channels.

The theory of algorithms deals with methods of formalizing problems, i.e. preparing them for machine solution. "Algorithm" is understood to mean a system of rules or operations which, when carried out in a particular sequence, make it possible to solve various different problems. For example, if the given initial data are the parameters of a nuclear burst and the necessary meteorological data, then certain mathematical relationships can be used to determine or predict radiation levels in contaminated territory.

The implementation of an algorithm by electronic computer is accomplished by working out a program for the given type of machine.

Algorithm development and programming are the processes of working out algorithms and programs. The working out of algorithms for operational tasks is a complicated problem requiring special mathematical knowledge.

On the whole, because of the complexity of the events which occur under present-day conditions on the field of battle and which require a large volume of the most varied calculations, mathematical methods of analyzing these events are acquiring great importance.

Mathematical methods make it possible to provide essential assistance to commands and staffs in finding answers to three fundamental questions which arise at all stages of preparing and conducting combat actions:

1. What is the anticipated result of the actions according to the existing plan for utilization of the allocated forces and means?
2. How many forces and means must be assigned to achieve a given result?
3. What is the optimal plan of actions for available forces and means?

The use of mathematical methods in military matters must be combined with logic and intuition on the part of commanders, since a commander's decision is always something more than the simple total of calculations.

The following must be included among the mathematical methods most widely applied in military matters: probability theory, game theory, linear programming, queueing theory and mathematical modeling.

Probability theory is the mathematical science dealing with the laws in random events. And since combat actions are typical examples of random

TS #768044
Copy # 2

events, probability theory finds wide application. Probability theory is used with particular success in calculations regarding prediction of the results of the employment of forces and means.

Game theory makes it possible to find the optimal solution in conflict situations in which opposing sides are pursuing opposite interests. Game theory may receive its greatest application in allocating forces for participation in active combat actions or as reserves, in choosing the structure and operating methods for troop groupings, in assessing the combat effectiveness of weapons systems, and in many other problems.

The methods of linear programming which have arisen during the last two decades find wide application in solving problems in which the allocation of any given means must be optimized within imposed limitations. Included here, for example, is the problem of optimal allocation of nuclear warheads among enemy targets.

Queueing theory examines the quantitative side of processes connected with organizing mass servicing. "Servicing", in the broad sense of the word, is here understood to mean the functioning of any system of equipment designed for the fulfilment of a mass of homogeneous requirements. Examples of such military systems are a group of surface-to-air guided missile systems, an aviation repair network of an air army, a personnel decontamination treatment system, etc.

Using this theory, it is possible to identify the main quantitative characteristics of the servicing processes in each specific system, to locate bottlenecks in the system, and to deliberately influence its improvement.

In recent years, the method of mathematical modeling of combat actions has come to be practised widely, making it possible, by implementing models worked out on electronic computers, to play out a large number of different variants of these actions in a relatively short time, taking into account the diverse factors which influence the course of combat actions in various ways.

The theory of control systems deals with: analysis of the structure of complex control systems; their performance in terms of the demands made on control by the nature of modern warfare; detection of bottlenecks; and, on the basis of these factors, synthesis of individual elements into that system and its necessary technical equipment which would provide the maximum degree of effectiveness in controlling the employment of all of the forces and means in an operation.

Depending on the degree of human participation in the control cycle, the theory of control systems distinguishes two types of systems: automatic and automated.

In an automatic control system, only monitoring is performed by human beings. Automatic systems can therefore be employed only to control weapons and combat equipment, for example, for guiding missiles and interceptor aircraft to the target, maintaining a prescribed rate of fire, etc.

In an automated system for controlling formations and large units of the armed forces, the role of the human being (the commander with his logical thinking, strong will, and decisiveness) is the main factor, while the system itself serves only as a means of expanding the commander's capabilities for creative work in analyzing a developing situation and in making decisions.

The need for a clear-cut division of functions between the human being and the machine is due to the fact that systems for controlling armed forces formations and large units usually consist of many organs, controlling and controlled, arranged in a specific hierarchical order. Each of these organs simultaneously exerts control (in respect to a subordinate organ) and is itself controlled (in respect to a superior organ).

Of the cybernetic equipment in automated systems, electronic computers occupy the most important place. The theory of control systems deals with requirements for computers, their design features, how they are linked up with various information sensors, and methods for output and documentation of the results of a machine solution.

At the present time, four generations of electronic computers can be distinguished.

First -- machines with elements in the form of electron tubes, with an operating speed of 10 to 15 thousand operations per second.

Second -- machines made up of semiconductor elements. Their operating speed is 10^5 to 10^6 operations per second.

Third -- machines with integrated circuits using microminiature elements. Their operating speed is 10^7 to 10^8 operations per second.

Fourth -- machines based on lasers, which are still considered in the theoretical stage. Their operating speed exceeds 10^{10} operations per second.

A very important direction in the theory of control systems is the working out of questions concerning the reliability both of individual components and of the system as a whole. In doing so, the determining factor will be operating reliability, i.e., the system's capability to meet the requirements placed on it by how the forces and means are to be employed in a battle or an operation.

TS #768044
Copy # 8

IV. <u>The employment of general-purpose computers in military districts</u>

The present-day military district, and especially the border military district, represents a large and complex troop entity provided with a considerable quantity of troops and troop installations for various purposes and cooperating with formations and large units of the armed forces branches deployed in the district's territory.

The principal task of military districts in peacetime is to constantly improve and maintain a high level of combat readiness of their troops. A high level of efficiency of control organs acquires particular importance in carrying out this main task.

The great number of different units, large units, and formations belonging to various branch arms, and their great quantity of complex equipment, involving tens and hundreds of thousands of different nomenclature designations, require a constant and uninterrupted supplying of materiel. The organizing of a flexible system of accounting and monitoring in this sphere presents a complex problem. At present, personnel of control organs spend up to 70 to 80 percent of their time working on accounting, planning and record documents.

The military district is the center where basic strategic, operational, and tactical concepts and views involved in working out all new questions of the conduct of combat actions in a future war are tested in peacetime. Also, the effectiveness of various complexes, systems, and means of combat and special equipment are tested and basic methods of employing them are developed in the military districts.

Finally, it is in military districts that comprehensive training of generals and officers in the correct utilization of means of automation and of the integrated automated systems being developed is carried out. Such training is already under way today on the basis of general-purpose computers.

With the onset of war, the districts comprising the first strategic echelon will immediately be reorganized into <u>fronts</u>. They must be the first to be equipped with mobile field automated control systems. As regards the districts located in the interior of the country, they will be assigned to conduct further mobilization, deliver various resources, train reserves, activate units and large units, organize their movement forward, prepare materiel reserves, protect the population, eliminate the aftereffects of enemy use of means of mass destruction, combat enemy airborne landing forces and sabotage groups, guard various troop installations, etc. The fulfilment of all these tasks also demands a high degree of efficiency in the work of control organs. Taking into account that working efficiency depends to a great extent on the ability to perform numerous calculations rapidly, one can conclude that it is necessary to equip the staffs of districts with computers. This is all the more necessary since, when war begins, the staff, directorates, departments, and services of the districts will be at reduced strength.

On the basis of principle, the activity of the control organs of military districts is divided into the everyday work connected with the control of troop activity in peacetime and wartime, and the comprehensive preparation of control organs to operate in the role of the field headquarters of a front or army, i.e., direct preparation of staffs to control troops during the course of a war.

Analysis of the activity of the control organs of a military district shows that the necessity for using general-purpose computers is felt in all directorates, departments, and services, since a great many computations, calculations, and predictions must be made during the course of their work, and a large volume of diverse information must be collected, processed, and stored. The manual performance of this work requires much time, lowers its quality, and removes a significant number of personnel from direct activity in the troops.

In the everyday work of a military district, it is the most desirable to use computers for planning an initial operation, working out a mobilization plan, working out measures to protect troops against means of mass destruction, and working out a system to keep account of the availability and movement of different materiel and combat equipment.

In a system for the operational training of staffs, it is desirable to use computers for solving operational-tactical problems connected with the employment of weapons of mass destruction, with the protection of troops and troop installations, with air defense, and with the main types of operational support.

If a district staff has computers attached directly to it, it will be possible to set up within that district a system for exchanging and processing information by computer. A system of information exchange is designed to ensure timely collection and transmission of the initial information needed to solve problems which arise in the course of everyday work and at command-staff exercises, and also to ensure the transmission of the machine solutions to the appropriate district command levels.

A system of information exchange comprises three basic components: sources of information, a computer center, and a communications system.

Information sources are divided into information posts and information centers.

Information posts are primary sources of information. They are organized within units belonging to divisions but deployed separately and within district rear services units and facilities deployed at separate garrisons. Information posts are equipped with terminal equipment capable of transmitting information (STA telegraph sets and automatic equipment) and with secure communications equipment or the M-125 coding machine.

Information centers usually are organized within the staffs of formations and large units on the base of their respective communications centers.

Computers and other calculating equipment, together with the communications center, its servicing personnel, and various auxiliary equipment, make up a computer center.

The most important component of the system is communications. Actual practice shows that the existing system and technical means of communication (assuming the employment of certain methods and of unsophisticated equipment for increasing reliability) make it possible to obtain, over operating communications channels, the reliability of the order of 10^{-4} to $10^{-?}$ [exponent missing] required to transmit information to computers. This is very important, since the development of new communications means with increased reliability parameters demands substantial material outlays and time.

The main method of processing information in such a system is to solve problems by computer.

Four categories of tasks can be distinguished within the everyday activity of a military district: operational, accounting-planning, mobilization, and table of organization.

Operational tasks include: calculations connected with planning an initial operation; the set of calculations to provide for combat readiness of the district troops and analyze the capabilities of the theater of military operations; calculations to determine the operating frequencies of radio sets; topographic calculations; etc.

Accounting-planning tasks constitute the bulk of the calculations. The tasks in this category include calculations connected with keeping account of the availability and movement of weapons, combat equipment, and various other items; with planning the receiving of equipment and materiel; with compiling record documentation of various types; with keeping statistical record documents; with finance functions; etc.

Mobilization tasks encompass numerous calculations regarding the personnel, weapons, equipment, and materiel required to work out the plan for mobilization expansion of the district troops.

Table of organization tasks include calculations connected with maintaining operational records on personnel on the basis of various characteristics, and with compiling reference data and record documents of various types.

The tasks which are to be performed by computer in the everyday activity of a military district within the time limits established by various orders, are categorized by periodicity as daily, weekly, monthly, quarterly, and annual or semiannual.

The experience of operating such a system in the Leningrad Military District over a period of two years indicates that on the average the time required for machine solution of everyday problems is 3.1 times less than for solution by manual methods.

With this system, the expenditure of labor can be reduced from two to 50 times -- 6.4 times on the average. This establishes the preconditions for increasing the operating efficiency of control organs and for freeing personnel previously occupied with performing various calculations.

In addition, the employment of computer equipment makes it possible to effect substantial indirect savings through economizing on ammunition in solving target allocation problems; through reducing expenditures for storage, normal losses, and obsolescing of materiel in solving accounting-planning problems; through reducing materiel reserves in solving problems of optimal allocation of materiel; etc.

For example, solving transportation problems associated with the optimal attachment of installations to supply bases makes it possible to reduce the average transport distances and the requirement for rolling stock, which in turn reduces transportation expenditures by 10 percent. And considering that the average annual transportation expenditures of a military district may be estimated at two million rubles, the economics effected through machine solution of such problems will reach a significant total -- 100,000 to 200,000 rubles.

The employment of general-purpose computers and other computer equipment in operational training undertakings has several distinctive features, most notably how the machine is set up. When a computer is set up as a stationary installation, the decisive factor for its effective employment will be the organization of reliable and stable communications between the computer center and the area in which the training exercises are being held. If a mobile computer (installed in vehicles) is employed, more favorable conditions are created for its use in staffs.

Another characteristic of the use of computers is the fact that in employing existing general-purpose computers in command-staff exercises and war games, it is not advisable to use them for tasks which involve the manual input of large amounts of initial information, since this requires substantial time. Such information tasks will be performed successfully if there are integrated automated systems where information will be fed in automatically from various sensors. Therefore general-purpose computers should be used mainly for calculation tasks which (in respect to the planning and conduct of a <u>front</u> offensive operation), can be broken down into the following groups:

-- calculations to be made in support of the overall planning of the operation;

-- calculations regarding the combat employment of rocket troops and artillery;

-- calculations for the planning and organizing of the air defense of the troops;

-- calculations for the protection of troops against means of mass destruction and for the employment of chemical weapons in the operation;

-- calculations for engineer support of the operation;

-- calculations connected with the organization and conduct of combat actions without the employment of nuclear weapons;

-- calculations for rear support of the operation.

One of the decisive conditions for attaining a high degree of efficiency in the employment of computer equipment in command-staff exercises and war games is appropriately planned and implemented preparation, which includes:

-- selection of problems in conformity with the concept of the command-staff exercise;

-- the holding of training courses for exercise participants;

-- the conduct of training practices for officers allocated from directorates, departments, and services;

-- the conduct of training practices for telegraphers;

-- the preparation of communications means;

-- the preparation of computer equipment;

-- the working out of a plan for using computer equipment according to the stages of the exercise, and organization of the process for circulating information between the computer center and the area in which the command posts are deployed.

Supervision of all preparations, and of the procedure for employing computers during exercises and war games, will usually be carried out by the chief of staff of the military district or his deputy. The automation department should be employed as the working body.

The outline for organizing the process of solving problems by computer during a command-staff exercise can be presented as the following six stages:

-- the command assigns a problem requiring the performance of necessary calculations by computer;

-- officers prepare initial data for transmission via communications channels;

-- initial data are transmitted to the computer;

-- information is prepared for input into computer and solution of problem;

-- the machine solution is transmitted via communications channels to the appropriate directorate, department, or service;

-- the solution obtained is analyzed and a report sent to the persons concerned.

As a rule, the computer calculating process occupies only five percent of the total time balance. The remaining time goes to the preparation of initial information, its transmisson over communications channels, its entry into various record books, and numerous other operations.

It becomes apparent from the foregoing that the more carefully the process of information handling is organized, the more effect there will be from employing computer equipment and the greater will be the operating efficiency of staffs.

Experience shows that the average time expended on solving problems by computer (from the moment a problem is assigned for calculation until the machine solution is reported) fluctuates within the limits of 60 to 90 minutes. If the officers are experienced in the employment of computer equipment and if there has been good preparation for the exercises, this time can be reduced to 25 to 30 minutes.

On the whole, the employment of computer equipment at command-staff exercises and war games makes it possible to reduce the time required to perform various calculations (as compared with manual methods) twofold to fourfold, to reduce the expenditure of labor an average of fourfold to fivefold, and to reduce the time required to solve individual problems tenfold.

Taking into account the critical need to increase the efficiency of troop control under present-day conditions, and the favorable experience of using stationary computer equipment for automation (mechanization) of certain processes in the activity of control organs, the Minister of Defense, in his directive No. D-057 of 4 September 1967, ordered: first, consider the introduction of computer equipment into control organs as one of the most important everyday tasks for increasing the efficiency of staffs and as a necessary condition for subsequently mastering the systems being developed; and second, during the period 1967-1970, set up computer posts and computer centers in the headquarters of military districts (groups of forces) and equip them with punchcard calculators and MINSK-22 general-purpose computers. At the same time, set up automation sections (departments) in all staffs of military districts and groups of forces.

In another directive, No. D-078 of 2 December 1967, the Minister of Defense ordered that the results of the scientific research project OPYT-2 be utilized to the maximum for automating the work of ground forces control organs, drawing widely for this purpose upon the experience of the Leningrad Military District, where a system of information collection and processing was set up and is functioning on the basis of the URAL-4 general-purpose computer. This same directive assigns the task of combining the computer centers of districts into a unified system connected to the ground forces computer center which is to be set up, providing, in doing so, for the capability to exchange machine solution results among control organs on the basis of standardized documents and common work methods.

The implementation of these orders will unquestionably increase the efficiency of the work of control organs and thereby increase the combat readiness of the armed forces.

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