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CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

12 January 1979

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MEMORANDUM FOR: The Director of Central Intelligence

FROM : John H. Stein
Acting Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): Solving Military-Economic Problems by Computer

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article examines a possible variant for using computers to determine the optimal structure for an operational-strategic system with minimum economic costs. In addition to a narrative description of the model, graphs of three different curves are provided which illustrate the relationships between the total cost of delivery vehicles and munitions, the quality and quantity of reconnaissance and control means, and the operational objectives to be achieved. This article appeared in Issue No. 2 (81) for 1967. [redacted]

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. For ease of reference, reports from this publication have been assigned [redacted]

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Intelligence Information Special Report

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SUBJECT

MILITARY THOUGHT (USSR): Solving Military-Economic Problems by Computer

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 2 (81) for 1967 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The authors of this article are Reserve General-Mayor of Aviation I. Klimashin, Engineer Captain Yu. Fedulov, and Engineer Major S. Selivanov. This article examines a possible variant for using computers to determine the optimal structure for an operational-strategic system with minimum economic costs. In addition to a narrative description of the model, graphs of three different curves are provided which illustrate the relationships between the total cost of delivery vehicles and munitions, the quality and quantity of reconnaissance and control means, and the operational objectives to be achieved. End of Summary

[redacted] Comment:

General-Mayor Klimashin and Engineer Major Selivanov also collaborated with Colonel V. Aleksandrov on "Predicting the Combat Losses and Balance of Forces of the Opposing Sides in an Operation" in Issue No. 2 (84) for 1968 [redacted]

Solving Military-Economic Problems by Computer

by

Reserve General-Mayor of Aviation I. KLIMASHIN
Engineer Captain Yu. FEDULOV
Engineer Major S. SELIVANOV

The resolutions of the Twenty-Third Congress of the CPSU call for economy and expediency in the expenditure of the means allocated by the state for any given construction. This precept is fully applicable to military construction as well. Every measure involving the development and employment of weapons, equipment, or defense installations must be examined with due consideration for its combat (operational) effectiveness and economy.

With this precept as a point of departure, we must continue the study, begun by Colonel General V. DUTOV,* of one of the important problems of military economists.

This is the problem of conducting the military-economic research needed to determine the course of future development and find the optimal proportions for structuring the armed forces branches and branch arms.

This problem is closely linked with the allocation of the military budget among the armed forces branches and branch arms.

In our view, the fundamental question of such military-economic research is to determine those proportions among the armed forces branches and branch arms which will provide for the attainment of military-political and strategic objectives during the course of a future armed conflict, with the fewest possible personnel casualties and economic outlays.

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* Colonel General of Quartermaster Service V. DUTOV. "Technological Progress and Tasks of Soviet Military Economists." Collection of Articles of the Journal 'Military Thought', No. 1 (77), 1966.

Solution of this problem calls for the development of a research system which will make it possible to allocate budgetary means on a scientific basis, taking into account the plans for the future development of the armed forces of a country and at the same time achieving close to optimum results. The method of calculating must reflect the actual characteristics and conditions of armed combat conducted by opposing sides at a definite time and in a definite place. It must also be taken into account that each side will commit several armed forces branches and a substantial number of branch arms, equipped in varying degrees with different types of weapons and equipment varying in power and effectiveness. Finally, we must also take into account the many limitations arising from the particular conditions and from the demands made by the military art of the belligerents and the limitations set by the military-political and strategic objectives of the conflict, the economic situation, and the resources of the country allocated for waging armed combat.

Thus, the problem which we are examining is so complex that it cannot be solved without using modern mathematical methods and computers. And for this purpose it is necessary first of all to work out an economic-mathematical model of military operations which will enable us to analyze many variants of the decisions which may be made by the belligerents, and in so doing to obtain an actual numerical result which will serve as a basis for working out practical recommendations for determining an optimal structuring of armed forces and branch arms and for determining their effectiveness. Only when this problem has been solved, i.e., only when the relative importance of a given armed forces branch or branch arm within the overall structure of the armed forces has been determined, can the economic practicality of a given system be determined, and consequently, only then can financial means be more properly allocated for the maintenance and further development of the forces and means composing this structure.

In our view, capabilities already exist for solving such complex problems. These capabilities are inherent in the successes of Soviet mathematical thinking and in the progress in the development of modern high-speed computers which perform calculations with a practical speed of several hundreds of thousands of operations per second and which have considerable "memories." There is also a well-trained body of mathematicians and programmers, who, together with military economists, specialists in strategy and operational art, and finance personnel of the Central Finance Directorate of the Ministry of Defense, are capable of developing a scientific methodology for solving such problems by computer and implementing the results.

This is why we support General V. DUTOV's proposal that one of the existing scientific research institutes be designated as the head institute responsible for working out solution methods and implementing them, for both individual and general problems of military construction. Such an institute, having several departments, would be able to solve many practical problems in conformity with the orders of the General Staff, the main staffs of the branches of the armed forces, and the Central Finance Directorate of the Ministry of Defense.

In our view, the scientific personnel of this institute should include not only officer mathematicians and programmers but also a number of specialists with an excellent knowledge of the fundamentals of modern strategy, operational art, and military economics. All in all, this should be a scientific association of qualified specialists, capable, in cooperation with the requesters who determine the research topics, of developing the foundations of a modern methodology and of carrying out complex military-economic research.

It is not impossible that such an organization could in the future, as experience is accumulated, become the nucleus, for example, of a military economic-mathematics institute capable of solving problems falling into the category of military construction in our country and also of working in support of the entire alliance of Warsaw Pact countries.

As regards the organization of the research work, it appears to us that it would be the most expedient to conduct it in stages, beginning, of course, with the least complex tasks which can actually be performed and can be brought to the stage of implementation relatively rapidly. Among these we may include:

a) research directed toward finding the optimal structurings of combat means in army and front operations (and then in individual theaters of military operations as well), in order to determine the structure and reveal the role of a given military system in a given structuring and the effectiveness and economy of this system;

b) research into the effectiveness and economy of specific means of delivering a given weapon (warhead) in a particular type of battle (operation).

In all instances we must proceed progressively from the simple to the complex, step by step improving the methodology and the mathematical research system and accumulating experience in the solution of military-economic problems first within the limits of the army -- front level, then on a theater-wide scale, and then on the scale of the armed forces of a country or coalition of countries engaged in two-sided combat with a powerful, technically equipped enemy.

As an example of the solution of military-economic problems by computer we may refer to our experience in working out a relatively minor research problem not provided for in the plan and solving it with a high-speed BESM-3M computer; the subject of the problem was: "Determination of the Optimal Structure of an Operational-Strategic System (SOSN)."*

The elements of such a system are first and foremost "active" components -- delivery vehicles of nuclear weapons (missiles, aircraft), nuclear strike means of varying yields, nuclear weapons depots and the means of delivering the weapons, airfields, and means of control and reconnaissance.

An operational-strategic system also includes so-called "passive" components which do not employ nuclear weapons but may be destroyed by them.

Each different type of means in an operational-strategic system is called an elementary unit. A combination of units of the same type is called a structural quantity, and the total number of structural quantities and their components, i.e., the number of elementary units, is the unknown quantity in an operational-strategic system.

The work was conducted in two stages.

In the first, after careful study of the military side of the question, a mathematical model of an operational-strategic system was worked out for two-sided combat, making it possible to conduct military-economic research by computer, observing the fundamental laws of military operations carried out for certain specific purposes. This requires mathematical description (modeling) of prolonged two-sided combat actions being conducted by operational-strategic systems of different make-up on the two opposing sides and differing in effectiveness and cost as expressed in monetary units.

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* By this we mean a general military system designed to solve problems on the army -- front scale. "SOSN" is, of course, a purely arbitrary term.

In the second stage, using this model, military-economic research was conducted, with limited operational objectives and taking into account the particular operational background, thus making it possible to choose the most economically favorable variant from among those found, i.e., the one closest to the optimal variant for structuring the operational-strategic system. This research utilized a specially developed methodology making it possible to consider the effect of the economic factors as a single quantity in solving problems of army or front operations.

According to this methodology, the advisability of introducing into the system any given number of structural quantities and elementary units -- means of destruction, munitions, control and reconnaissance means -- will be determined by the extent of their "contribution" to the achievement of the operational objectives and by the quantity of resources needed to get these means into the system in the required amounts.

Under these conditions, the problem of determining the optimal structuring of an operational-strategic system by our method is reduced to finding, with regard to one's own forces, that initial number of elementary units of each type (structural quantity) which will ensure achievement of the operation's objectives with the minimum possible economic outlays and assuming a fixed (given) make-up of forces on the enemy side.

As the criterion determining the degree to which the objectives of a planned operation must be achieved, we take the difference which will be brought about in the so-called "passive" components by the end of an operation R* as a result of two-sided combat, or in other words, a favorable balance of forces between the two sides on the basis of the given components.

For example, in a front operation, this will mean that the difference in the number of tank and motorized rifle large units which are still combat effective by the end of the operation will be a difference in favor of our forces, i.e., the balance of these forces needed to carry through the operation will be in our favor.

The model assumes optimal control on each side. This makes it possible at each step (i.e., in each fixed time segment -- from several minutes to a full day, during which both sides conduct combat actions within the model) to allocate the available delivery vehicles with nuclear munitions in such a way as to destroy enemy targets, taking into account the quantitative limitations on both delivery vehicles and munitions and the degree to which targets on both sides have been reconnoitered before and during the operation. The degree to which targets are reconnoitered, expressed as a percentage of the total number of enemy targets of a given type at all stages of the operation, and the capability to destroy detected enemy targets with "active" means, are represented in the model by an index of the quantity and quality of the control and reconnaissance means.

While giving due attention to the influence exerted on the course and outcome of an army or front operation or on an entire war by such factors for victory over the enemy as troop morale, the quality of officers' training, and the proficiency of field commanders in the art of troop leadership, we have unfortunately not been able to include them in our calculations, since it is still not possible to express the influence of these and other such factors in terms of specific quantities, and this in turn makes it difficult to introduce them into the process of numerical analysis which is carried on in military and military-economic research.

In order to determine the extent of their influence and to introduce them into numerical analysis, it is our view that further military-scientific research is required in the areas of military art, social psychology, and sociology.

The introduction into analysis of these factors in the form of specific and sciently based coefficients will unquestionably increase the effect of research and will bring it closer to actual conditions in simulating armed combat.

But let us return to our model, which has been used to conduct research to determine the quantitative and qualitative interdependency of various elements within the structure of an operational-strategic system and the degree of their influence on the ultimate objectives of an operation and on the economic cost of the whole system expressed in conventional monetary units.

For this purpose, a great many variants were processed on a BESM-3M computer; the results are set forth in three graphs (Graphs 1-3).

Graph 1 illustrates the dependence of the total cost (C_Σ) of delivery vehicles of nuclear weapons and munitions on the quality and quantity of reconnaissance and control means (ν), with a given difference in the number of passive means remaining by the end of an operation (criterion R^*). As we see, the cost of the system (not counting the cost of reconnaissance and control means) drops noticeably as the quality of reconnaissance and control means improves. With poor reconnaissance quality, the cost of the operational-strategic system rises sharply.

It follows from this graph that there is a minimum permissible quality level for reconnaissance and control means below which the cost of an operational-strategic system becomes an infinitely large quantity, i.e., unrealizable in practical terms. Analysis of the graph's indices leads to the conclusion that it is impossible to expend means productively on any given structural quantity (armed forces branch, branch arm) without observing scientifically based principles. In particular, if the objectives of an operation (R^*) are to be attained, the quantity and quality of reconnaissance and control means must not be reduced to the poorest level shown on the graph.

Graph 2 sets forth the dependence of the total cost of delivery vehicles and munitions (C_Σ) on the objectives of an operation, i.e., the values for the criterion R^* with the given quantity and quality of reconnaissance and control means (ν). The greater this criterion and the lower the quality of reconnaissance and control means, the higher will be the cost of delivery vehicles and munitions in an operational-strategic system.

It is noteworthy that with a given quantity and quality of reconnaissance and control means there are values for R^* for which the cost of delivery vehicles and munitions increases infinitely, and realization of such R^* values becomes impossible. In this case the command must make a choice: improve the quantity and quality of reconnaissance and control means or deliberately undertake a revision of the operation's objectives, i.e., lower the level of the criterion R^*. In other words, the same operational objectives can be achieved with various different quantitative and qualitative means of reconnaissance and control, but the cost of an operational-strategic system will become higher as the quantity and quality decrease. It is also evident from the graph that under all other equivalent conditions, there will still exist structural proportions for an operational-strategic system such that its total cost can be kept to a minimum.

This situation is shown visually in Graph 3, which considers the dependence of the total cost of an operational-strategic system on the

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quality and quantity of reconnaissance and control means, with given operational objectives (R*). It is evident that there exists a minimum below which the cost of an operational-strategic system cannot be reduced, under given conditions, and that if this condition is observed, the operation's objectives (R*) will be achieved and proportions optimized according to three structural quantities: reconnaissance and control means, delivery vehicles, and munitions, with a given number of one's own motorized rifle and tank divisions and other large units and units participating in the operation, and assuming a fixed make-up of all enemy forces.

We have examined one of the possible methods of solving a purposely simplified military-economic problem in which limitations were imposed on the structural make-up of an operational-strategic system: one type of delivery vehicle, one type of munitions, one type of reconnaissance and control means, and one type of so-called "passive" means.

In actuality, however, many armed forces branches and branch arms will participate in front and army operations conducted in a theater of military operations, as well as in armed combat in general, i.e., there will be systems of a more complex order. This circumstance complicates the problem but does not exclude the possibility of solving it successfully. Moreover, we believe that the patterns revealed in the course of research on the structure of an operational-strategic system and shown visually in the graphs will retain their fundamental meaning and influence for solving problems of this type.

The example cited above indicates that under present-day conditions it is possible to solve military-economic problems by computer, i.e., to find nearly optimal structures and costs for military operational-strategic systems, so constituted as to satisfy two basic requirements: operational-strategic expediency ensuring the attainment of an operation's objectives and minimum possible economic cost for both the system as a whole and its individual structural quantities.

The solution of such problems will in the future provide the command with a better foundation on which to work out projected plans for the development of the armed forces branches and branch arms and also to determine the volume of budgetary appropriations and other means necessary for this purpose.

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