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CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

7 March 1975

MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : WARSAW PACT JOURNAL: The Creation of a System of Operational-Tactical Problems for an Automated Control System

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on articles from a SECRET Soviet publication called Information Collection of the Headquarters and the Technical Committee of the Combined Armed Forces. This article reviews the results of using computers in troop control systems in a number of combined operational-tactical exercises. The author explores such information processing problems as selecting and inputting data, building a data base, and controlling the processing system. This journal is published by Warsaw Pact Headquarters in Moscow, and it consists of articles by Warsaw Pact officers. This article appeared in Issue No. 6, which was published in 1974.

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

William E. Nelson
Deputy Director for Operations

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[redacted]

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Intelligence Information Special Report

COUNTRY USSR/WARSAW PACT

DATE OF INFO. 1969-February 1974

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SUBJECT

WARSAW PACT JOURNAL: The Creation of a System of Operational-Tactical Problems for an Automated Control System

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article from a SECRET Soviet publication called Information Collection of the Headquarters and the Technical Committee of the Combined Armed Forces. This journal is published by Warsaw Pact Headquarters in Moscow, and it consists of articles by Warsaw Pact officers. This article was written by Engineer General-Leytenant B. Kuchera, who reviews the results of using the Czech model ZPA-600/S and other computers in troop control systems in a number of combined operational-tactical exercises. The author explores such information processing problems as selecting and inputting data, building a data base, and controlling the processing system. This article appeared in Issue No. 6, which was published in 1974.

End of Summary

Comment:

There is no information in available reference materials which can be firmly associated with the author.

The names of authors are given in Russian transliteration. Ranks of one-star (general-mayor) and two-star (general-leytenant) general officers are given in Russian for nationals of countries following the Soviet system.

The Creation of a System of Operational-Tactical Problems for an Automated Control System

by
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Deputy Chief of the General Staff
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The period through which we have passed in the development of control is characterized by purposeful experimentation in the field of utilizing means of automation and mechanization at operational and tactical control levels. The present article touches upon several problems of developing and utilizing complex operational and tactical problems to be solved by computer, and their supporting mathematics.

Capabilities for Processing a System of Operational-Tactical Problems by Machine

In about 1970, the armies of the Warsaw Pact members began extensive preparations for resolving the problems of automating control processes at the formation and large unit command levels. Up to the present time, considerable experience has been obtained, especially in the utilization of operational-tactical problems which are solvable with the aid of a computer.

Utilization of means for automating and mechanizing control in the combined operational-tactical exercises ODER-NEISSE, BROTHERHOOD-IN-ARMS (BRATSTVO PO ORUZHIYU), and SHIELD-72 (SHCHIT-72) was sufficiently extensive to enable staff officers to become acquainted with the nature and capabilities of means of automation and mechanization and, in line with their own functional responsibilities, to familiarize themselves with problems which can be solved with the aid of computer equipment.

At these exercises, the organs for automating and mechanizing troop control acquired skill in planning and conducting exercises using automated and mechanized means in armies of coalition makeup, and exchanged experience in the use of new technical means in staff work and procedures

for reconciling programs developed in the individual armies.

Stationary computer centers functioned during the course of operations, and, having a well-organized communications system, in the initial period they substituted for mobile means of automated and mechanized data processing.

All of the exercises in which automated means were used confirmed the necessity of turning from the creation of independent, mutually exclusive problems to solving operational-tactical problems as complexes of problems, using a common data bank (information field of source data). This conclusion is dictated by the fact that, in our view, the development of operational-tactical problems individually has numerous deficiencies. In the field of information collection and transmittal, these may be summarized as follows:

-- in the process of receiving and collecting source data for the solution of operational-tactical problems, the same staff organs receive the same information many times;

-- there is no single format for source information, and its recording on various forms is fairly complicated;

-- redundant source information is enciphered and transmitted.

In processing operational-tactical information by computer, the solution of individual, autonomous problems gives rise to some undesirable phenomena:

-- complexity of inputting operational-tactical problems and of controlling their processing by computer servicing personnel;

-- time loss in inputting programs for operational-tactical problems into computer memory units because of the lack of a unified method of program development for them.

Naturally, the deficiencies mentioned did not arise at once. They were revealed by a previously conducted organizational-technical experiment which, under the conditions of the given personnel, technical, and organizational support, could not have produced other results.

The basic difficulties in creating a system of operational-tactical problems, which persist up to this time, and the compulsory necessity of solving them independently, are explained by the limited capabilities of the second generation computer equipment being used, particularly of its supporting mathematics.

In processing information by computer, as is well known, different machine operation modes can be employed:

-- the discrete sequential mode, in which one program is input into the machine, and is used for solving the problem until the final results are obtained;

-- by batches, in which the problem programs and their machine commands are written in the same form, and the computer, after processing one program, automatically introduces another program. For this purpose a special complex of control programs is being created to replace certain functions of computer servicing personnel. This program complex has been designated an operating system, which differentially employs all modes for machine processing of information;

-- a multiprogram mode, in which individual programs in turn are processed in sections in order to assure optimal utilization of the arithmetical and peripheral devices of the machines;

-- with the use of communications means, in which in addition to multiprogram processing there is a rapid and alternating exchange of information between the computer and peripheral devices available to the operator;

-- a multiprogram (interactive) mode with a capability for information exchange between machines, which most closely approximates requirements for machine processing of information in automated control systems.

Regardless of the operating mode by which problems are processed, there are, at the present time, two basic approaches to the machine processing of information in decision-making control processes: the heuristic approach and the algorithmic.

The first method is based on a system of logical methods and methodical rules and on an attempt to organize sequential machine processing in such a way that it will most closely approximate human thinking. Its results are not preliminarily ordered since it is assumed that the information processing system will continuously introduce new elements, obtained by experience, into the sequence of its operations.

The second method assumes that in algorithmic systems of information processing, a solution according to the appropriate algorithm is assured primarily by using complete and reliable input information. These systems of machine processing of information are usually subdivided into several types. The most feasible breakdown is into document and factographic systems.

Document systems are designed for the retrieval of documents from among a large number of documents whose contents, complete or abbreviated, are stored in computer memory units. These systems retrieve documents of prespecified content. It is characteristic of these systems that facts are obtained only from documents.

Factographic systems are designed to process facts. It is assumed here that the data to be processed constantly change in volume. These systems are characterized by the fact that the memory units of the machines designated for information processing store facts (in document systems -- documents), which the machines can accummulate, retrieve, and process (document systems retrieve, and in exceptional cases process, documents on the basis of the facts contained in them).

From the viewpoint of machine operating modes, both factographic and document systems of information processing can operate in any mode.

Specific requirements for a machine information processing system are derived from the operational-tactical requirements (efficiency, flexibility, continuity, reliability, capability for centralized or decentralized operation, strict security, hierarchical structure, mobility) placed on the automated control system and its subsystems.

The most important of these requirements are:

-- timely collection of information for troop control according to the established form and content;

-- the capability to take into account changes in the organizational structure of forces;

-- integrated processing within the framework of the system and the individual subsystems;

-- universality, providing for expansion and alteration of functions in response to requirements of commands and staffs;

-- the possibility of communications between subsystems and elements within the subsystem framework;

-- conformity of input and output information with the standardized combat and operational documentation employed.

Evaluating these requirements, one can conclude that a machine information processing system must possess the features of factographic information processing systems which operate utilizing a communications system mode or an interaction mode.

Implementation of a factographic system presupposes improved technical equipment. This pertains particularly to computer speed (hundreds of thousands of operations per second); the capacity of the memory unit (at least 265 K bytes); the availability of a corresponding number of external memory units and access to them (disks, magnetic drums, etc), etc.

It is assumed that in a field automated system of troop control, the appropriate automated equipment, introduced into the individual automated control subsystems, will have the indicated technical parameters.

Creation of a System of Operational-Tactical Problems

The questions involved in solving a given problem may be broken down as follows: selection of operational-tactical problems; data base of the system of operational-tactical problems, its technical control and buildup; creation of a program to control the processing of operational-tactical problems; development of program support for processing and debugging the programs of operational-tactical problems; and resolution of questions involved in controlling the system.

The questions which must be resolved in planning and setting up a machine system for processing integrated operational-tactical problems are so closely interrelated that breaking them down has meaning only in the methodological sense.

The predesignation and selection of an operational-tactical problem and its inclusion in the system will depend on a number of factors. The essence of the problem must satisfy the information requirements of the corresponding staff organ. In solving a given problem by computer, the formulation of the problem and its translation into algorithms will depend on the thoroughness of the analysis by means of which the information requirement has been established. From the theoretical viewpoint, information requirements and the operational-tactical problems deriving from them must be determined on the basis of a full analysis of the processes involved in decision-making and information processes of control.

In actual practice, this is almost unrealizable for two reasons. First, because complete analysis of information processes and decision-making processes requires an enormous amount of work. Second, information processes and decision-making processes in the control field are for the most part essentially heuristic in nature. In implementing

them, commanders and staffs rely on experience and gradual improvement under conditions which are often characterized by great fluidity and indefiniteness. The arguments introduced are the reason why only a limited portion of operational-tactical problems are included in the problems system.

In our view, operational-tactical problems may be subdivided as follows:

-- information problems (status and position of troops, conditions of strategic and combat operations);

-- calculation problems (operational-tactical calculations);

-- optimization problems (seeking the optimum variants for operations and for groupings of forces and means).

Experience shows that combined-arms automated control subsystems employ primarily information problems; automated subsystems for controlling rocket troops and artillery, front aviation, and air defense employ calculation and optimization problems; and an automated subsystem for controlling combined-arms rear services employs calculation and information problems.

The solution of operational-tactical problems is based on a large amount of efficiently ordered information called an information system. The concept of a data base as a component of a data bank* is taken to mean that portion of the information system which is stored in the memory units of the machines being used for information processing.

The problem of a data base encompasses the resolution of two questions: ordering of the content and determination of how the content will be recorded.

The first question is answered by analyzing the content of the input information for various classes of operational-tactical problems. This can be accomplished by numerous methods. Regardless of which method is employed, it must assure the unambiguous identification of information with a specific class of problems, must have the capability of including new information in any of the classes, and must provide the minimum number of classes necessary to discern the individual elementary input information of the various operational-tactical problems.

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*A data bank is a component of a machine processing system, consisting of two parts: the content (data base) and the technical part (technical control of the data base).

Experience shows that there is no need, in classifying, to change the categorization of operational-tactical information which has proven itself in actual practice into information regarding our own forces, the enemy, natural conditions, combat and operational actions, etc.

A more detailed breakdown of operational-tactical information on our own forces and the enemy is possible, for example, in relation to the arms of troops and services to which they belong. We can break the given information down even further if we subdivide it into operational-tactical categories: composition of forces, location, situation, operations, support of troops, etc.

Ordering of the contents of the data base is one of the means which make it possible to ensure the compatibility of the information within a given automated control subsystem and between separate automated subsystems.

The necessity for specific expression of the data base in an established form derives from the requirement to store information in the memory units of information processing machines. The rules for standard expression of the data base derive not only from the technical characteristics of the machines but also from the ordering of the data base according to content and from the rules for composing standardized operational and combat documentation.

The technical part of the data base is a program system which makes it possible to process the information stored in the data base.

In order to solve systems (complexes) of operational-tactical problems, it is necessary that the data base be independent of the nature and form of the input information for individual problems.

Data in a computer memory unit must be stored in such a way that they can be combined by means of a special program and thus use the source information to solve any problem from the complex. This, in our view, is the basic difference from the traditional ordering of input information, according to which it is ordered in conformity with the algorithm and program of an operational-tactical problem. The person solving the problem can obtain the sought for information from the data base in the required sequence regardless of how it is stored.

In creating a data bank, it is clearly necessary, together with the above requirements, to provide for the following features: information

readiness (i.e.,the data bank must be set up in such a way that it can produce the appropriate information without sorting and substantial time losses); absence of superfluous information (no information in the data base is repeated); and flexibility (the capability to alter the content of the internal structure of the data base).

Satisfying the requirements placed on the data bank and the ordering of its content and structural form, also make it possible to resolve its efficient technical control, which must assure the capability: to store information in the data base in such a way as to ensure the high information readiness of the data bank; to set up an access procedure so that information can be retrieved in response to requirements; to accomplish the rerecording of information from its external carriers to the internal memory unit and vice versa; and to store and refine data in the data base.

Building up a data base for a system of operational-tactical problems consists of ordering input information by content and form, and of accumulating it in the data base. This process involved certain difficulties deriving from the characteristics of the language used to express the input information. The same word in a different context may have a different meaning, and input information can be expressed in several ways or words. For this reason there must be a single way of describing all the factors which enter into operational-tactical problems as input information.

It should be noted that in controlling a system for processing operational-tactical problems in automated systems, one very essential difficulty is encountered, which requires the creation of a special control language. This language includes instructions for requesting solutions to operational-tactical problems and for asking the system to perform further operations on behalf of the requesting staff organ. The determinant condition here is the requirement that the structure of the language correspond to the social-psychological skills of the staff officers who are doing the work. The control language and the overall method of system control are determined and effectuated by the corresponding developers of the automated control subsystems.

Czechoslovak People's Army Experience in Solving a System of Operational-Tactical Problems

On the basis of experience obtained during exercises using means of automation, we set about solving an integrated system of operational-tactical problems for the staff of an operational formation. The system was provisionally named GOLIASH. Initially the system comprised 22 operational-tactical problems connected with the preparation of data for the commander to use in making a decision. In 1972 the GOLIASH system was tested in the combined operational-tactical exercise SHIELD-72. An integrated system of operational-tactical problems GOLIASH-SHCH-72, was created, which successfully carried out its tasks.

The goal of creating the GOLIASH system was to make its characteristics approximate as closely as possible a factographic system processing information on a real-time basis. The principal limitations arising during the employment of this system were caused by the technical parameters of the computer (a mobile computer* of Czechoslovak manufacture, the ZPA-600/S).

As is well known, one of the most important principles in deciding on a system for processing information by machine is the principle of storing source data for operational-tactical problems. This decision may be made on one of the following possible bases:

-- each individual problem has its own necessary source data;

-- there is one data base for all problems, out of which each problem selects its own required data;

-- there is a specific data base which can be used by all problems and, in addition, each problem has its own data mass.

The GOLIASH system was set up in such a way that for all the problems there is a single data base in which input data for the operational-tactical problems are sorted without duplication. In their overall characteristics, this system and its modifications (GOLIASH-1, GOLIASH-2, GOLIASH-SHCH-72) resemble a program system which processes information by batches. The adoption of this system signifies undoubted success in the field of machine processing of information as compared with the solution of operational-tactical problems individually. Success was achieved first and foremost because the integrated and manipulated programs of the system perform the function of operating systems of third generation

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*Speed of computation -- 40,000 operations per second; word length -- 12 decimal symbols; capacity of operational memory unit -- 2,000 words, four magnetic tape memory units; high-speed line printer; etc.

computers. Those who are developing this approach understand that, with the introduction of third generation computers into the armies of the Warsaw Pact member states, further success in the field of integrated processing of a system of operational-tactical problems can be achieved primarily by raising the quality and increasing the quantity of the operational-tactical problems.

In this article, we have set forth only the main questions regarding the creation of a system of operational-tactical problems for automated control systems. Our experience in this field is still limited; however, operation of the GOLIASH-SHCH-72 system shows that the path chosen for integrating the programs of operational-tactical problems utilizing a single data base is sufficiently well grounded.