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20 July 1978

MEMORANDUM FOR: The Director of Central Intelligence

FROM : John N. McMahon
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): The Introduction of Network Methods of Planning and Control into the Practice of Scientific Research Institutions

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 recounts the main problems one may expect when network planning methods are adopted and reassures us that the advantages justify the effort. Since the purpose is chiefly to persuade, the article does not go into great detail. This article appeared in Issue No. 2 (84) 1968. [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]

John N. McMahon

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Page 1 of 12 Pages

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SUBJECT

MILITARY THOUGHT (USSR): The Introduction of Network Methods of Planning and Control into the Practice of Scientific Research Institutions

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 2 (84) 1968 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article, by Engineer Lieutenant Colonel Yu. Belousov and Engineer Major P. Polyakov, recounts the main problems one may expect when network planning methods are adopted and reassures us that the advantages justify the effort. Since the purpose is chiefly to persuade, the article does not go into great detail.

End of Summary

[redacted] Comment:

Major Polyakov also contributed to "The Use of Mathematical Methods of Network Planning in Military Affairs," in Issue No. 3 (82) for 1967 [redacted]

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The Introduction of Network Methods of Planning and Control into the Practice of Scientific Research Institutions

by
Engineer Lieutenant Colonel Yu. BELOUSOV
Engineer Major P. POLYAKOV

Existing methods for planning scientific research based, as is known, on textual plans or bar graphs do not leave room for the use of economic levers to encourage the most satisfactory fulfilment of plans and do not permit modern computer equipment and mathematical methods of finding efficient solutions to be widely enlisted for planning.

The shortcomings of traditional planning and control methods often cause the nonfulfilment of research work within the planned time limits, the overexpenditure of means, the uneven workload of executor organizations, etc.

A way out of the situation which has evolved was found through the development of the so-called network planning and control methods, which have a number of advantageous features. Among these should be included primarily the capability to present a plan in concise graphic form and to separate data on segments of those tasks directly influencing the achievement of the final goal from the entire mass of reporting-planning information, and also the capability to calculate the interdependence of separate tasks and to reflect a certain amount of uncertainty when estimating their duration. Because of their merits, in a short time network planning and control methods have received widespread distribution in the most varied spheres of human activity, including the military.* Nevertheless, one cannot say that the introduction of network planning and control always proceeds rapidly and smoothly. This process is linked with the overcoming of definite psychological barriers and difficulties of organizational and technical procedure.

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* See "Military Thought", 1965, No. 12; Collection of Articles of the Journal "Military Thought", 1967, No. 1 (80).

This article attempts to analyze the difficulties of the introduction of network planning and control methods into the practice of scientific research institutions of the Ministry of Defense, so that available experience can be considered when applying these methods to the activities of staffs at all levels and the central and main directorates of the Ministry of Defense, to control of the combat crews of weapons systems, and to other military tasks.

To begin with, it is necessary to keep in mind that the introduction of network planning and control presupposes the rejection of old methods of control and the mastering of new ones by all supervisors. Of course, a change in customary operating procedure inevitably generates some opposition. Therefore, when introducing network planning and control methods in one or another form, one encounters expressions of disbelief in their effectiveness and reluctance to change over to a new system. This can be seen in attempts to prove the unsuitability of network planning and control methods for planning creative activities and in the effort to prove the inadvisability of their introduction, given the existing organization of tasks.

As a rule, a network planning and control system devotes more attention to tasks in the critical zone, often to the disadvantage of other tasks having large time reserves. Therefore, the transfer of some of the personnel of some subdivisions to others and the first-priority supply of the most important tasks with people and materials, etc. are possible under those circumstances when it is necessary to establish the conditions for the timely fulfilment of decisive tasks. It is entirely understandable that the directors of institutions (departments) carrying out less important tasks will not be strong adherents of network planning and control methods.

The difficulties of overcoming psychological barriers to the introduction of network planning and control methods are aggravated by a number of organizational and technical shortcomings, as a result of which the effect which the employment of network planning and control can have is not achieved in some cases. For example, a negative attitude towards network planning and control finds a place to grow when the use of these methods is accompanied by large additional expenditures of time by supervisors in drawing up and analyzing the documents

of a network planning and control system. This is usually connected with an insufficient level of development of the technological process of operation of the system.

However, experience shows that, with the acquistion of skills in working with network diagrams, the total time spent by supervisors on planning, monitoring, and working out decisions does not increase, yet the quality of planning and control increases substantially.

Organizational shortcomings more strongly influence the effectiveness of a network planning and control system the more complex is the interdependence of the organizations executing a set of tasks. For example, if network planning and control is introduced for planning the task of an individual subunit (laboratory, combat crew), then no serious organizational difficulties arise since all personnel in the subunit are subordinate to one supervisor and carry out all of his orders. When network planning and control is introduced throughout an institution, organizational difficulties arise because of the necessity of correctly distributing functions among the supervisors of various levels (laboratory, department, directorate) and among the supervisors of a single level (group of departments executing a single theme). In this situation, there is now no supervisor to whom all coexecutor departments are administratively subordinate when carrying out the majority of the research work although the scientific director is able to influence them through the institution's command.

Similar difficulties are even more clearly exhibited if the network planning and control system covers the operation of several coexecutor organizations, particularly when these include not only military, but also organizations from other ministries and agencies. Here there is practically no single organ at all to which all these organizations would be subordinate.

The distribution of functions among the supervisors of a single level is necessary for the following reasons.

At the present time there exist institutions of the branches of the Armed Forces which conduct a large amount of research work on the instructions of their commanders-in-chief. At the same time these are frequently engaged as coexecutors to carry out

integrated research work assigned by the government or Ministry of Defense.

It is totally understandable that the "compartmental" interests of an institution do not always coincide with the goals set for integrated research work. But the institution is responsible to the commander-in-chief for the fulfilment of compartmentalized work while it does not bear such direct responsibility to anyone for tasks accomplished as a coexecutor. Attempts to resolve such conflicts by appointing head organizations are not always effective since the head organization does not have the administrative authority to supervise integrated research work. In our view, when using a network planning and control system to supervise complex sets of tasks, it is advisable to establish a supervisory organizational group with the authority to resolve conflicts arising among the coexecutors in the interests of the overall goal. For example, when military organizations together with organizations from other ministries and departments fulfil a set of tasks, it is advisable to include supervisory representatives from each agency (chiefs of the main directorates, deputy ministers, etc.) in such a group. The decisions of the supervisory group must be binding on all coexecutors. Experience in using network planning and control during the conduct of major military experimental design work completely confirms the necessity of establishing such supervisory groups.

The essence of the problem of the correct distribution of functions among the supervisors of various levels is to discover such a degree of detail for the network diagrams and to establish such a procedure for their approval and adjustment that would leave room for the initiative of ordinary executors and supervisors while simultaneously maintaining the requirements for unity in technical policy and observance of the set time limits for completing the work. For this purpose, in a network planning and control system, several degrees of detail on network diagrams are established in accordance with the existing supervisory hierarchy. The supervisor of each level is authorized to adjust the network diagram of the tasks of a subordinate subdivision to the extent that this adjustment does not lead to the displacement of events included in the diagram of a higher level.

There are also organizational difficulties in introducing network planning and control which are inherent to control systems on any level.

At the present time precise, planned time limits are established for fulfilling all tasks. At the same time the labor consumption, cost, and other indices are planned. However, scientific and other creative activity will always retain some element of chance; for example, it is impossible to accurately plan in how many days one or another discovery will be made. Such uncertainty is particularly characteristic of combat actions.

Of course, when planning these types of tasks it would be wise to specify in advance the allowable deviations of the planned indices and to take these into consideration when estimating the fulfilment of plans. Such planning with regard for the uncertainty of the duration of the tasks is provided for in a network planning and control system. Each task for which precise standards cannot be established during planning is estimated by using the minimum, most probable, and maximum time needed to accomplish it. (Sometimes only the minimum and maximum times are used.) The average value for the duration of each task and the nature of its uncertainty, which in the future will serve as the basis for establishing the planned time limits for accomplishing the tasks and the allowable deviations, are calculated on the basis of the estimates presented.

As is known, monitoring the progress of the tasks is an essential element of supervision. Its main purpose is to determine the correspondence of the actual progress of the tasks to the planned progress, to reveal difficulties and shortcomings which arise and methods for eliminating them, and also to determine the degree to which research and development work is nearing its final goal.

The success of the entire work depends to a great extent on the correct organization of monitoring.

Until the present, periodic monitoring of the progress of all planned tasks has been practiced at a number of scientific research institutions of the Ministry of Defense. Since the number of tasks, as a rule, is very large, their content

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extremely varied, and the monitoring time short, thorough checking becomes practically impossible and monitoring often becomes a formality. Of course, in this case the true objectives of monitoring cannot be achieved by the monitoring results.

It is not surprising that with such a monitoring system decisions are primarily made on those problems on which the command possesses more complete information. As a rule, the degree to which tasks are nearing their final goals is evaluated under these circumstances only in the final stages of the tasks, when too little time may remain for eliminating the shortcomings.

Based on the principle "control by the method of elimination," a network planning and control system provides the capability to subject to thorough and daily monitoring only those tasks on which the timeliness of the achievement of the final goals depends. (On a network diagram such tasks usually comprise 10 to 15 percent of the overall number, and these form the "critical zone.") Because of such a distribution of the most important tasks, the supervisor's attention is concentrated each time on those sectors which in a given situation principally determine the success of accomplishing the entire project within the set time limits.

Concerning the remaining tasks which constitute the "reserve zone," here monitoring may be carried out by simplified methods, for example, by checking only instances of the completion of separate events.

As experience shows, such an approach to the monitoring of tasks sharply increases monitoring quality. In addition, during each calculation of a network diagram, network planning and control methods make it possible to determine the probability of accomplishing the entire work within the set time and to judge the degree to which it is nearing the final goal of the research work.

If the indicated probability increases in the course of development, then the tasks are proceeding successfully. A decrease in the probability of accomplishing research work within the set time indicates delays in the fulfilment of separate tasks lying on the critical path or located in the critical zone.

When carrying out complex research, deviations from planned time limits arise, some tasks turn out to be unwarranted, and new tasks are revealed which were not provided for in the original plan. All of this necessitates an adjustment of the plans. However, the existing adjustment procedure is unwieldy and not sufficiently flexible, and adjustment is entirely prohibited in the second half of the quarter.

Thus, the urge arises to avoid adjusting plans and to "adapt" report data to the planned indices. There are known to be cases when, because of difficulties connected with adjustment, even those planned tasks which at that time had already become scientifically inadvisable were accomplished.

Conversely, the use of network planning and control methods implies the necessity of obligatory periodic adjustment of the plans in accordance with the results of the regular readjustment and calculation of the network diagram.

A network planning and control system gives the process of planning and controlling tasks necessary dynamic qualities, since within defined limits the adjustment of noncritical tasks becomes the prerogative of the immediate supervisors. A higher level supervisor is called on only in those cases when the adjustment necessitates the displacement of the times for achieving events on the extended network diagram for the corresponding level.

The operation of a network planning and control system for a large set of tasks is possible only when special network planning and control services are available in the executor organizations, and primarily in the head organization. Experience demonstrates that the central network planning and control service must be formed as a special subdivision; either special subdivisions or individuals from the directorate's subdivisions can act as peripheral network planning and control services. Thus, it is possible to avoid an increase in the administrative-management staff by eliminating the complex and voluminous reporting-planning documents and replacing them with network planning and control system documents.

The existing awards procedure in scientific research institutions does not objectively encourage a reduction in time limits and in expenditures for accomplishing research and

development work. Without incentives, hidden reserves often remain undiscovered.

A network planning and control system establishes conditions favorable to the use of methods of economic incentives for tasks accomplished ahead of schedule, well, and economically. Network diagrams make it possible to set an increased reward for the accomplishment ahead of schedule of tasks lying on the critical path.

The range, which we have examined, of organizational difficulties in introducing network planning and control to a certain extent depends on the specific nature of the activity of the Scientific Research Directorate of the Ministry of Defense. Some of these difficulties are not characteristic of the operation of staffs and other military institutions. However, we can confidently state that when network planning and control methods are introduced in any sphere, great possibilities arise for the more precise organization of tasks and the timely elimination of various types of obstacles appearing on the path to the established goal.

Psychological barriers and organizational difficulties in introducing network planning and control are also aggravated by a number of unresolved problems of technical and mathematical support.

In the sphere of technical support for network planning and control systems, it is a question of equipping executor organizations with the appropriate receiving-transmitting equipment and of equipping the central network planning and control service with devices for rewriting information which ensure its rapid input into computers and with alphanumeric printers for the output of results in the form of documents, etc.

A serious technical support shortcoming in existing network planning and control systems is the large amount of labor consumed by drafting tasks. Now, as a rule, all network diagrams and planning documents are drafted manually.

The unsatisfactory technical equipping of network planning and control systems leads to a situation where much information becomes outdated in the time the initial data on the status of

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tasks goes through laboratories until a decision is made at the ministry level. This particularly cannot be tolerated in military affairs.

A sharp reduction in the passage time of information in network planning and control systems becomes possible only with the automation of the most labor-consuming tasks of the technological process itself.

In the sphere of mathematical support, existing network planning and control methods require improvement in analysis methods and in the practical use of the great quantities of diverse information which can be obtained with machine processing of the networks.

It is also necessary to develop various simplified methods for the manual processing of network diagrams.

On the basis of the experience of the employment of network planning and control for research and development work, we can assert that mathematical methods of network planning and control have vast possibilities and permit a sharp increase in the quality of the planning and control of large sets of tasks. The enormous effect achieved with their use must provide utmost stimulation to overcome the difficulties standing in the way of the introduction of network planning and control methods in the various spheres of military activity.

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