[redacted]

TOP SECRET

[redacted]

4923

CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

13 February 1974

MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : MILITARY THOUGHT (USSR): The Use of Network Planning in the Organization of Research

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 discusses the principles of network planning and the advantages of its use in military research. Tables are used to demonstrate savings in manhours and rubles through use of network planning, but neither the specific type of work nor the research facility is identified. This article appeared in Issue No. 2 (90) for 1970.

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.

[redacted]

William E. Nelson
Deputy Director for Operations

[redacted]

Page 1 of 17 Pages

TOP SECRET

[redacted]

[redacted]

[redacted]

Distribution:

The Director of Central Intelligence

The Director of Intelligence and Research
Department of State

The Joint Chiefs of Staff

The Director, Defense Intelligence Agency

The Assistant to the Chief of Staff for Intelligence
Department of the Army

The Assistant Chief of Staff, Intelligence
U. S. Air Force

Director, National Security Agency

Deputy Director of Central Intelligence

Deputy to the Director of Central Intelligence
for National Intelligence Officers

Deputy Director for Intelligence

Deputy Director for Science and Technology

Director of Strategic Research

Director of Scientific Intelligence

[redacted]

[redacted]

Intelligence Information Special Report

COUNTRY USSR

[redacted]

DATE OF INFO. Mid-1970

DATE 13 February 74

SUBJECT

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

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 2 (90) for 1970 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The author of this article is General-Mayor of Engineer-Technical Service V. Kuznetsov, Candidate of Technical Sciences, Assistant Professor, State Prize Laureate. This article discusses the principles of network planning and the advantages of its use in military research. Tables are used to demonstrate savings in manhours and rubles through use of network planning, but neither the specific type of work nor the research facility is identified.

End of Summary

[redacted] Comment:

The author may be identical with Gen.-Mayor Kuznetsov, a professor at the Air Force Engineering Academy i/n N. Ye. Zhukovskiy in 1960, Red Star, 23 November 1960. State Prize Laureate Gen.-Mayor Vladimir Filippovich Kuznetsov was identified as an assistant professor in 1970. Military Thought has been published by the USSR Ministry of Defense in three versions in the past -- TOP SECRET, SECRET, and RESTRICTED. There is no information as to whether or not the TOP SECRET version continues to be published. The SECRET version is published three times annually and is distributed down to the level of division commander.

[redacted]

The Introduction of Network Methods of Planning and Control Into the Practice of Organizing the Work of Research and Testing Institutions

by
General-Mayor of Engineer-Technical Service
V. Kuznetsov,
Candidate of Technical Sciences, Assistant Professor, State Prize Laureate

The problems of organizing scientific research, especially in the field of development of armaments and military equipment, have now become the subject of great attention from both the scientific-research institutions themselves and all managerial organs.

In accordance with the regulations in effect, scientific-research institutions of the Ministry of Defense are charged with fulfilling such complex and responsible tasks as determining the prospects for the development of armaments (establishing armaments programs), developing and substantiating tactical-technical requirements for new systems, and testing models of complex technical systems. For these tasks to be carried out on the level of the best achievements of world science and technology, a scientific-research institution must have sufficiently strong specialized collectives (departments or laboratories), responsible for the creation of new models of armaments and military equipment. These purposes are served by the conversion of several scientific-research institutions of the Ministry of Defense to the so-called matrix organizational and manning structure (Chart 1), by which specialized departments and laboratories carry out the tasks of their sector for the entire body of topics of the institute. Under this structure often about ten different laboratories and departments participate in carrying out one topic of scientific-research work. If the annual plan of a scientific-research institution contains several tens of topics, organizing the combined, coordinated work of a large number of such collectives poses a very complex problem, insufficient attention to which results in a marked decrease

in the effectiveness of the scientific research of the institution.

Being, on the whole, indisputably progressive, the matrix structure of a scientific-research institution ensures high-quality fulfilment of a large number of planned topics in a very short time, without increasing (often unjustifiably) the staff of the scientific-research institution. However, these results may be attained only by considerably increasing the scientific-organizational activities of the management personnel of the scientific-research institution, from the chief of the laboratory to the director of the institution inclusive, and enlisting all scientific personnel for active participation in this work.

(See Chart 1 at end of report)

Examining the aims and essence of scientific-organizational activity under the matrix structure, even in the most general terms, requires specially emphasizing the effect which the unavoidable uncertainty of prognoses in any scientific research has on the nature of this work. This means that the allocation of tasks among the departments and their established time limits will be constantly changed and clarified as new data are obtained during research. In this connection the essence of scientific-organizational activity primarily comes down to continuously optimizing the process of combined work of the structural subunits of the scientific-research institution on an assigned topic. It is no accident, therefore, that scientific-research institutions recently have been seeking appropriate methods and forms for the most effective organization of collective research, and persistently introducing methods of planning, monitoring and controlling research which are better and more suitable to new working conditions.

One of the most progressive of these methods is <u>the system of network planning and control</u> which is innately more adaptable than the others to the management of large-scale collective research with a large number of coexecutors working under conditions of unavoidable uncertainty of prognoses in the course of the work.

The system of network planning and control, in which the "target of control" is the collective of executors with fixed material and financial resources, has as its purpose ensuring the collective's productive activity, aimed at achieving the projected final result.

The use of the network planning and control system in organizing collective research is based on the following simple and reasonable principles. Before work begins (on the whole topic or a section of it), its whole course is planned with sufficient detailing and specifying to determine the executors (collectives), their particular tasks, the procedure of cooperation and required material support. Each executor (collective) determines the probable time frame and amount of work required to accomplish his (its) particular assigned task, and clarifies the procedure of cooperation with other executors, proceeding from the basic condition of completing the task in the minimum time or with the least expenditures of manpower and means. The final work plan is formulated on the basis of selection of the methods of solving the particular tasks by the executors; the time limits and amount of fulfilment of each of the tasks are estimated in terms of probability.

The basic content of the planning and control process is the optimization of the plan of the entire work or its remaining part (while it is being fulfilled) according to a given criterion (for example, ensuring the minimum time period for completion or the least possible expenditures of manpower, or fulfilment of the maximum amount of work by the available manpower. The plan is viewed as a dynamic document, subject to analysis and, when necessary, adjustment; the latter is carried out in accordance with the results of the regular cycle of optimization. Mandatory optimization upon receipt of new data and the adoption of measures for putting the optimized plan into effect are the basic content of control in the planning and control system.

Of all the known methods of the network planning and control system, the one most suitable for scientific-research institutions of the Ministry of Defense, which operate as budgetary organizations under strict organizational-staff limitations, is the so-called multiprogram system. Under this system, separate work is not planned and optimized independently; coordinated and

interdependent annual planning of all topics of the scientific-research institution is important, as is adjustment of the separate topic plans in keeping with the overall plan. The main objective of such planning and control is to ensure qualitative fulfilment of the maximum amount of work with the existing manpower and with regard for the scientific specialization of the manpower.

While the above-mentioned multiprogram system of network planning and control was being developed and introduced, there were worked out in our organization new principles (algorithms) for planning and controlling research, a corresponding allocation of responsibilities of the officials and a new system of planning and accounting documentation.

Network plans of topics and network plans of subunits (of a department, laboratory or group of executors) form the basis of all documentation. The network plan of a topic replaces the work program and is formulated throughout the period of the topic's fulfilment. It includes a network chart and a list of the work and developments, and is approved by the chief of the scientific-research institution. Under this plan the level of detailing is selected in such a way that each department-coexecutor has a precisely and specifically formulated task for basic stages of research. The most important developments being monitored by the management of the scientific-research institution are noted on the project network chart of topics. The sum total of these developments on all topics of the annual plan (two to four developments per year on each) will be presented by the chart of the monitoring of the course of fulfilment of the annual plan.

The network plan of a scientific department, used for streamlined organization of the work of the collective, contains, in addition to the tasks of that department on all topics of the annual plan of the scientific-research institution, work and developments which support the work of the scientific department, the conduct of seminars, the writing of articles, training of the scientific cadres, improvement of the experimental base, etc. It also includes the network chart and the list of work and developments, and is worked out for a year. The detailing and specifying of the plan of the department is analogous in structure to the

network plan of the laboratory (group of the responsible executor), in which the work for each executor (on the average, one job per month) is formulated precisely and in detail.

Since the system of management in the scientific-research institution is multi-step, four levels of it are designated: the command of the scientific-research institution, the command of a scientific directorate, the chief of a department, and the chief of a laboratory (responsible executor). Each level has corresponding rights for approving and adjusting plans, as well as responsibilities for detailing, monitoring and controlling them. The plans of all levels are coordinated so that the formulations of tasks or work from the plans of a higher level of management are incorporated into all plans of a lower level without any changes.

The complexity of the process of compiling and optimizing an institution's annual plan of topics, which is unwieldy in its number of tasks and executors, necessitates working it out by the method of consecutive approximations using computers, and by enlisting a large number of executors in this work to independently determine the methods of solving tasks and how much work each requires. Therefore the system incorporates the principle of combining a centralized initiation of planning on the part of the management of the scientific-research institution with initiative study of the tasks and the methods of solving them by the executors.

The following important principles are based on the algorithm of planning by the multiprogram system of network planning and control.

For each topic a scientific-organizational concept is developed which encompasses a description of the degree to which the problem has been studied before work is begun on the topic, a formulation of all basic tasks and the sequence in which they are to be solved, a comparative analysis and a substantiation of the selection of the best methods of research. Analogous work is performed for each particular task in departments and laboratories.

To ensure better coordination in the work of the chiefs of scientific departments and the scientific managers of topics, and to ensure collective leadership in management by the latter, a topic council is formed for each topic and is made up of the responsible executors from each department-coexecutor; the immediate scientific manager of the topic heads the work of the council.

Network plans of topics and departments are developed and optimized in parallel.

And, finally, in the system of network planning and control, quarterly planning is considered as a direct continuation and development of the annual plan.

The multiprogram system of network planning and control provides for easier planning of financial-economic indices, which somewhat facilitates moving manpower and means around to fulfil the annual plan, and frees the scientific departments from detailed calculations.

Control under this system is, in essence, a continuous process of planning and optimizing the remaining amount of work on the basis of analysis of the course and results of the portion already fulfilled. The main tasks of control are: monitoring the actual fulfilment of work; bringing to light and analyzing changes arising in the course of research; working out and adopting solutions; carrying out organizational-technical measures which ensure timely and qualitative fulfilment of works; and finding ways and methods of reducing the amount and the duration of work in the process of conducting research.

In the course of such planning, a possible movement of manpower and means within subunits or between them may be made, and the content and time limit for fulfilling work on one or several topics, may be changed.

The algorithm of control contains the principle of actively enlisting in control the management of all levels, with the conferring on it of certain rights. Each chief can independently distribute and redistribute manpower and funds among topics within a subunit or among subordinate subunits (within the bounds of overall assigned limits). He also has the right to adjust a plan that he has approved, as long as,

In doing so, he does not infringe upon items incorporated into it from documents approved by a senior chief.

For control purposes, a monitoring system is organized to bring to light the actual status of work and adopt measures in connection with the changed conditions of its fulfilment. The completeness of the monitoring is ensured by enlisting the management of all levels in it, in accordance with the principle that the senior man monitors the junior men.

Monitoring is effected along two lines: by topic (by responsible executors, scientific managers and topic councils) and administratively (by chiefs of laboratories, departments and directorates and by the command of the scientific-research institution). These lines merge on the directorate and institution management level. The monitoring periodicity is determined by the officials and scientific managers and depends on the nature of the work, its interrelation with other topics and also on the scientific training of the executors.

The multiprogram system of network planning and control described above was developed in our organization after experience showed that a monoprogram system of the "network planning and control-time" type (analogous to the American PERT-TIME system) was unsuitable. An experiment was conducted for five quarters to check the progress and effectiveness of using the new system, with the condition that all algorithms were strictly fixed and no system changes whatever were allowed.

Since up to the present time methods and criteria of direct quantitative evaluations of the effectiveness of various systems of organizing collective scientific work have not been developed, relative quantitative evaluations were conducted by comparing the volume of fulfilled research and the saving in the salary fund for equal operating periods of the scientific-research institution, before and after the network planning and control system was introduced (1964-1965 and 1967-1968, respectively). The validity of this comparison is based on the fact that for a number of reasons (in particular, a significant turnover and retraining of approximately one-fourth of the scientific personnel in 1967-1968), the average level of personnel

qualification and experience was virtually the same in the periods compared, and changes in the overall personnel strength and in estimates of expenditures were allowed for by corresponding recalculation.

However, comparing the amount of fulfilled work on the basis of the number of topics worked out during a year is not significant. Therefore, comparisons were made on the basis of the number of major tasks carried out in the periods being examined. First, the number of these tasks was determined according to data of the analysis of technical objectives (TZ). In doing this, it was taken into account that technical objective requirements and the order of their being worked out in the periods being compared did not change, and the level of detailing work in the technical objectives remained the same. For that reason, the number of major tasks carried out was determined according to the results of analysis of the accounts of the scientific-research work and tests. The data obtained is given in Chart 2.

(See Chart 2 at end of report)

Taking into account the sufficiently large number of tasks being compared, we can consider the results of the stated analysis to be reliable, and confirm that, due to increasing the productivity of work by introducing the system of network planning and control, the amount of work fulfilled in the second period increased by approximately 60 percent.

Also counted was the saving in the salary fund, obtained only through such effects of the network planning and control as bringing to light and eliminating duplicative work from plans, synthesizing tasks in departments, fulfilling above-plan work, and eliminating work which, according to the data of current analysis, has been made unnecessary in the course of fulfilment of topics. These data are shown in the table (the cost of one man-hour changed in the periods being compared from 2 rubles 7 kopeks to 2 rubles 25 kopeks).

(See Table at end of report)

The actual saving of means was more than 314.6 thousand rubles, since the calculations did not take into account the saving of equipment and materials which corresponded to the manpower expenditure saving. One also can point out that in the periods being compared, the numbers of authors' certificates received, and complex methods and models developed for deeper research, all increased (by 26, 89 and 47 percent, respectively), which indisputably indicates the completeness and improvement of the quality of their conduct. The reduction of the time required for finishing work (20.6 percent) and obtaining intermediate results (72.4 percent) in the periods being compared also is very positive.

One must remember that the described system of internal organization of scientific-research institution work we introduced still is incomplete and produces only part of the effect that can be obtained from it. The relatively slow pace of its actual assimilation is explained by a number of reasons.

First of all, there are difficulties connected with the special features of conducting a social experiment aimed at intensifying the labor of the workers and increasing the amount of scientific-organizational work of the managers without a noticeable increase of material incentive.

Secondly, there are fundamental difficulties of specific planning of scientific research under conditions in which, as a rule, its course and results are unavoidably uncertain, and the related complexity of creating a system which resolves this contradiction as far as possible.

Thirdly, this requires not only large-scale training of all personnel for the transition to the new planning and control methods, but also systematically intensive educational work, aimed at overcoming established habits and traditions and at psychological reorientation of all the workers.

Finally, one must not fail to mention the complications involved in fulfilling a number of formal requirements of the existing system of financial-economic planning, which prevent fully putting into effect basic principles and tenets of the network planning and control system.

The experience we have gained allows us to state that the introduction of network planning and control methods into the practice of organizing the work of scientific-research institutions of the Ministry of Defense will provide great advantages. Providing specificity in planning and operational control of the course of research primarily results in improving the organization of the complex activity of the scientific-research institution conducting major scientific research. The productivity of collective work in fulfilling scientific-research and testing work is increased significantly due to more complete and uniform use of the resources of the scientific-research institution. Also, the quality of the development of scientific-organizational concepts and plans for fulfilling topics increases, since a large number of qualified scientific personnel are enlisted in their development and review, and, consequently, the collective nature of the research is taken into account to a large extent. Detailing and specifying in the planning of work, more precise allocation of tasks, and an increased level of organization of the conduct of scientific research within departments by means of network plans, substantially improves cooperation and rhythm in the work of subunits and facilitates growth of the personal responsibility of managers and executors for the quality and results of the research being conducted, and for its fulfilment.

As is well known, the scientific organization of work (NOT) is not a one-time act, but a process of systematic and regular improvement of the forms and methods of collective activity, aimed at increasing the effectiveness and improving the conditions of work. Among the many trends in the scientific organization of work in the scientific-research institutions of the Ministry of Defense (such as streamlined distribution of functions among the various categories of personnel, regulating working time, equipping working areas, creating optimum working conditions, improving documentation, setting standards for non-creative, repetitive processes, training personnel in the most

[redacted]

[redacted]

streamlined procedures and methods of conducting research, and so on), the introduction of network planning and control methods unquestionably is the most important. Radically strengthening the scientific-organizational activity of managerial personnel on all levels of a scientific-research institution, with wide use of network planning and control methods actually represents, in essence, a continuous process of developing the forms of the collective labor of researchers, for the purpose of ensuring that at every moment of time each executor independently and creatively does only that which is prescribed by the optimum plan of collective work. In this way, (even according to not very optimistic appraisals) it is possible to raise the productivity of the work of the collective of a scientific-research institution 1.5 to 2 times.

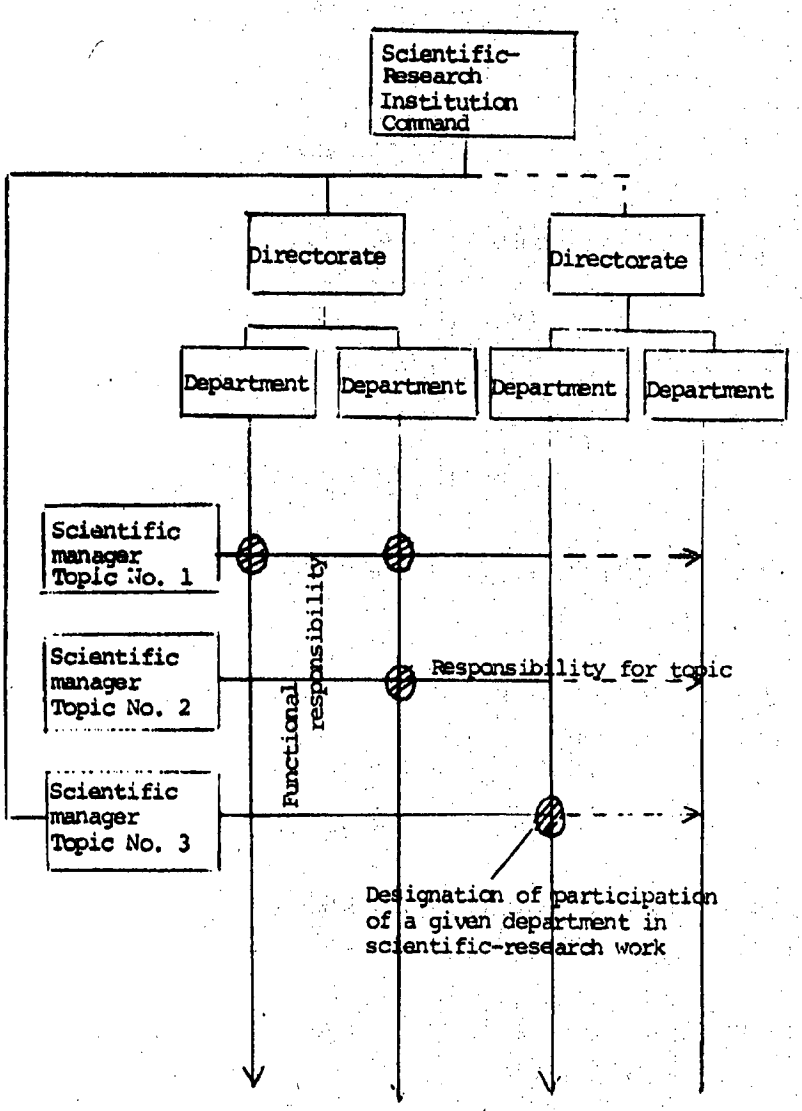
[redacted]

[redacted]

[redacted]

[redacted]

Chart 1 - Matrix organizational and manning structure of a scientific research institution.



Matrix organization and manning structure of a scientific-research institution

[redacted]

Chart 2 - Diagram of growth of the amount, and labor consumption, of fulfilled work before and after introducing the system of network planning and control

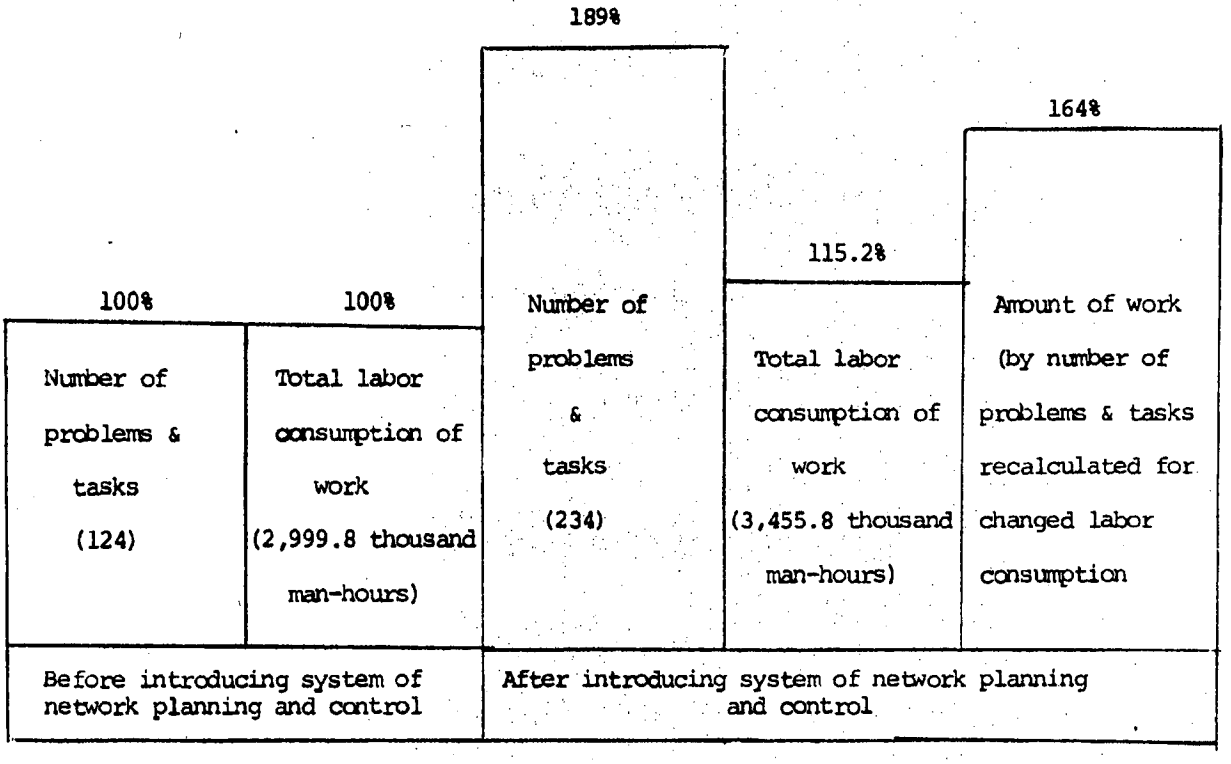


Diagram of growth of the amount, and labor consumption, of fulfilled work before and after introducing the system of network planning and control

[redacted]

[redacted]

Table

Work categories	Total labor consumption and cost of work				Relative saving in salary fund in thousands of rubles
	1964 - 1965		1967 - 1968		
	in thousands of manhours	in thousands of rubles	thousands of manhours	thousands of rubles	
Eliminated from plans:					
as duplication	-	-	12.0	27.0	27.0
due to synthesis of tasks in departments	8.3	17.2	54.7	123.1	105.9
as result of current monitoring during optimization	9.6	19.9	68.3	153.6	133.7
Fulfilled over & above established plans	68.0	140.8	83.9	188.8	48.0
Total	85.9	177.9	218.9	492.5	314.6

[redacted]