

THIS FILE IS MADE AVAILABLE THROUGH THE DECLASSIFICATION EFFORTS AND RESEARCH OF:

THE BLACK VAULT

THE BLACK VAULT IS THE LARGEST ONLINE FREEDOM OF INFORMATION ACT / GOVERNMENT RECORD CLEARING HOUSE IN THE WORLD. THE RESEARCH EFFORTS HERE ARE RESPONSIBLE FOR THE DECLASSIFICATION OF THOUSANDS OF DOCUMENTS THROUGHOUT THE U.S. GOVERNMENT, AND ALL CAN BE DOWNLOADED BY VISITING:

[HTTP://WWW.BLACKVAULT.COM](http://www.blackvault.com)

YOU ARE ENCOURAGED TO FORWARD THIS DOCUMENT TO YOUR FRIENDS, BUT PLEASE KEEP THIS IDENTIFYING IMAGE AT THE TOP OF THE .PDF SO OTHERS CAN DOWNLOAD MORE!

AD-A217 609

(2)

IDA DOCUMENT D-682

COST AS A FACTOR IN SOVIET WEAPONS DECISIONMAKING

DTIC
SELECTE
JAN 29 1990
S D CS D

Andrew W. Hull
Peter B. Almquist

October 1989

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited



INSTITUTE FOR DEFENSE ANALYSES
1801 N. Beauregard Street, Alexandria, Virginia 22311-1772

20 01 00 008

IDA Log No. HQ 89-34913

DEFINITIONS

IDA publishes the following documents to report the results of its work.

Reports

Reports are the most authoritative and most carefully considered products IDA publishes. They normally embody results of major projects which (a) have a direct bearing on decisions affecting major programs, (b) address issues of significant concern to the Executive Branch, the Congress and/or the public, or (c) address issues that have significant economic implications. IDA Reports are reviewed by outside panels of experts to ensure their high quality and relevance to the problems studied, and they are released by the President of IDA.

Group Reports

Group Reports record the findings and results of IDA established working groups and panels composed of senior individuals addressing major issues which otherwise would be the subject of an IDA Report. IDA Group Reports are reviewed by the senior individuals responsible for the project and others as selected by IDA to ensure their high quality and relevance to the problems studied, and are released by the President of IDA.

Papers

Papers, also authoritative and carefully considered products of IDA, address studies that are narrower in scope than those covered in Reports. IDA Papers are reviewed to ensure that they meet the high standards expected of refereed papers in professional journals or formal Agency reports.

Documents

IDA Documents are used for the convenience of the sponsors or the analysts (a) to record substantive work done in quick reaction studies, (b) to record the proceedings of conferences and meetings, (c) to make available preliminary and tentative results of analyses, (d) to record data developed in the course of an investigation, or (e) to forward information that is essentially unanalyzed and unevaluated. The review of IDA Documents is suited to their content and intended use.

The work reported in this publication was conducted under IDA's Independent Research Program. Its publication does not imply endorsement by the Department of Defense or any other Government Agency, nor should the contents be construed as reflecting the official position of any Government Agency.

This Document is published in order to make available the material it contains for the use and convenience of interested parties. The material has not necessarily been completely evaluated and analyzed, nor subjected to formal IDA review.

Approved for public release; distribution unlimited.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public Reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE October 1989		3. REPORT TYPE AND DATES COVERED Final--December 1988 to August 1989	
4. TITLE AND SUBTITLE Cost as a Factor in Soviet Weapons Decisionmaking				5. FUNDING NUMBERS IDA Independent Research Program CRP 9000-216	
6. AUTHOR(S) Andrew W. Hull, Peter B. Almquist					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institute for Defense Analyses 1801 N. Beauregard St. Alexandria, VA 22311-1772				8. PERFORMING ORGANIZATION REPORT NUMBER IDA Document D-682	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Intuitively, one believes that cost ought to be a significant decisionmaking factor in the Soviet weapons acquisition process. If that is indeed true, then DoD decisionmakers should be quite interested in when, how, and to what extent cost shapes the outcome of the Soviet weapons acquisition process. However, interest alone is not enough. There must also be sufficient data available about the role that cost plays in the process. With these perspectives in mind, the authors undertook this project, under IDA's Independent Research Program, aimed at: (1) ascertaining whether DoD officials were in fact interested in the impact of cost in shaping Soviet weapons choices, and, if so, where this concern might play in the U.S. decisionmaking process; as well as (2) identifying potential data to address DoD's concerns. The project was limited to about six man-weeks of effort (split between two analysts). Hence, the results are necessarily modest. Nevertheless, this preliminary investigation revealed that there is interest in the topic and that data are available to address several significant issues.					
14. SUBJECT TERMS Soviet, Cost, Decisionmaking, Weapons acquisition				15. NUMBER OF PAGES 31	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR		

IDA DOCUMENT D-682

COST AS A FACTOR IN SOVIET WEAPONS DECISIONMAKING

Andrew W. Hull
Peter B. Almquist



October 1989

Accession For	
NTIS	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution	
Date	
A-1	



INSTITUTE FOR DEFENSE ANALYSES

IDA Independent Research Program
CRP 9000-216

ABSTRACT

Intuitively, one believes that cost ought to be a significant decisionmaking factor in the Soviet weapons acquisition process. If that is indeed true, then DoD decisionmakers should be quite interested in when, how, and to what extent cost shapes the outcome of the Soviet weapons acquisition process. However, interest alone is not enough. There must also be sufficient data available about the role that cost plays in the process.

With these perspectives in mind, the authors undertook this project, under IDA's Independent Research Program, aimed at:

- (1) ascertaining whether DoD officials were in fact interested in the impact of cost in shaping Soviet weapons choices and, if so, where this concern might play in the U.S. decisionmaking process; as well as
- (2) identifying potential data to address DoD's concerns.

The project was limited to about six man-weeks of effort (split between two analysts). Hence, the results are necessarily modest. Nevertheless, this preliminary investigation revealed that there is interest in the topic and that data are available to address several significant issues.

CONTENTS

Abstract	iii
Executive Summary	S-1
I. FRAMING THE PROBLEM	1
A. Background	1
B. Approach	1
II. AREAS OF RELEVANCE	3
A. Cost-Imposing Strategies	4
B. Cost Effectiveness at the Margin	5
C. Costing the Soviet Threat	6
D. Final Observations	7
III. RESULTS OF THE PRELIMINARY LITERATURE SEARCH	8
A. The Level of Decisionmaking and Decisionmakers	9
B. Types of Decisions	12
C. The Nature of the Decision Options	14
D. The Impact of Concern Over Costs	15
E. Who is Concerned About Costs and How They Are Measured?	15
F. Final Observations	15
APPENDIX A--Bibliography	A-1

EXECUTIVE SUMMARY

Intuitively, one believes that cost should be a significant factor in Soviet decisional calculus about which weapons systems to procure and in what numbers. This should be especially true now that Mikhail Gorbachev asserts an intention to reduce Soviet defense spending.

If that is indeed true, then Department of Defense (DoD) decisionmakers should be interested in when, how, and to what extent cost shapes the outcome of the Soviet weapons acquisition process. Our investigation revealed three areas in which DoD would particularly benefit from increased understanding of cost as a Soviet decisionmaking factor:

- Formulating U.S. cost imposing strategies,
- Assessing U.S. cost effectiveness at the margin, and
- Costing Soviet threat options to specific U.S. programs.

Preliminary data searches also suggest that there is information available to shed some light on how cost shapes the outcome of the Soviet weapons acquisition process. These information sources can be categorized according to five broad themes:

- level of Soviet decisionmaking and type of decisionmaker;
- type of decisions;
- nature of decisions;
- impact of concern over cost on the outcome of decisions;
- role of different actors in estimating costs, approving expenditures of resources, and monitoring the subsequent implementation.

Although our investigation revealed a need to understand how cost functions in the Soviet decisionmaking process, this is not an end in itself. Instead, understanding the role of cost is better envisioned as a tool that will help DoD officials make better decisions about other topics. Consequently, it may not always be clear to potential beneficiaries that they should take the intermediate step of studying cost as a decisionmaking factor. Nevertheless, we believe that doing so is important and so the necessary spadework ought to be undertaken.

I. FRAMING THE PROBLEM

A. BACKGROUND

Intuitively, one believes that cost should be a significant factor in the Soviet weapons acquisition process, especially now that Mikhail Gorbachev intends to reduce defense spending. If that is indeed true, then Department of Defense (DoD) decision-makers should be interested in when, how, and to what extent cost shapes the outcome of the Soviet weapons acquisition process. However, interest alone is not enough. Sufficient data must also be available to shed meaningful insights.

With these perspectives in mind, the authors undertook a project under IDA's Independent Research Program which focused on:

- (1) ascertaining whether DoD officials were indeed interested in the impact of cost in shaping Soviet weapons choices and, if so, where this concern might play in DoD deliberations; as well as
- (2) identifying potential data to address DoD's concerns.

The results of this effort are necessarily modest since the project only expended six man-weeks of effort, split between two analysts. Nevertheless, these resources were sufficient to reveal that there is interest in the topic and that data are available to address several significant issues.

B. APPROACH

The issues raised above were addressed in two primary ways. First, project participants interviewed senior Defense Department officials to solicit their views on relevant concerns. At the same time, members of the Intelligence Community were queried on state-of-the-art knowledge about cost and effectiveness in the Soviet weapons decision-making process.

The other major effort was aimed at identifying potential data sources. This involved searching a number data bases and indices, including:

- Defense Technical Information Center data base;
- RAND index of classified and unclassified studies;
- Defense Intelligence Agency *Register of Intelligence Publications*; and
- Defense Intelligence Agency *Scientific and Technical Intelligence Register*.

More specifically, the authors scoured these sources for information about key Soviet organizations (e.g., the General Staff, the Military Industrial Commission), functional topics (e.g., Soviet discussions of cost and effectiveness algorithms), and historical incidents (e.g., public debate between Brezhnev and the military about the appropriate levels of defense spending). The resultant list of potential source documents was then screened (based on data base abstracts) for relevance. Next, hard copies of interesting items were ordered and examined in a preliminary fashion. (See the bibliography in Appendices A and B.)

II. AREAS OF RELEVANCE

Soviet weapons costs have long been of major concern to the Department of Defense and the Intelligence Community. Indeed, considerable attention each year goes into costing Soviet weapons systems and then into aggregating individual system estimates into total Soviet defense costs. Additionally, aggregate figures are compared against U.S. estimates of Soviet gross national product to assess the military burden to the economy as a whole.

Some U.S. analysts argue that such costing has become a guidepost for assessing the adequacy of U.S. defense spending as well as a surrogate for the Soviet military threat.¹ However, this approach to costing is really pricing exercises and, consequently, does not deal directly with how cost functions as a decisionmaking factor in Soviet deliberations.

Unfortunately, these standard treatments of cost gloss over a number of profound questions:

- Do Soviet decisionmakers really think about military issues in economic terms?
- Do they consciously trade cost versus effectiveness?
- Do Soviet military (or political leaders for that matter) ever worry about the relative costs of specific weapons systems or their defense program as a whole versus U.S. counterparts?
- Do Soviet decisionmakers even know about either the absolute costs or the overall economic opportunity costs of defense expenditures? If so, do they care?
- If defense costs are known and seen as important, how do these perceptions affect the outcome of the Soviet weapons acquisition process?

At least one respected U.S. commentator on Soviet affairs believes that such questions are central to understanding the Soviet defense decisionmaking process, but that

¹ Stephen M. Meyer, *Economic Constraints in Soviet Defense Decision-Making*, Center for International Studies, Massachusetts Institute of Technology, p. 1.

such questions have, for the most part, been ignored.² In fact, our brief survey of people and literature suggests that such questions are recognized as central to several major DoD initiatives, but that the issues are seldom confronted directly. Rather, these questions are subsumed as assumptions in analyses being undertaken for other purposes.

That notwithstanding, our interviews suggested three areas where understanding Soviet attitudes toward cost could make a contribution to DoD. These were: (1) cost-imposing strategies, (2) cost effectiveness at the margin, and (3) costing the Soviet threat.

A. COST-IMPOSING STRATEGIES

The issue of cost as a Soviet decisionmaking factor bears most directly on DoD concerns about formulating and implementing cost-imposing strategies according to the people we interviewed. It is significant in two ways. First, U.S. analysts must understand if Soviet leaders are swayed by the issue of costs in their weapons choices and, if so, at what threshold that concern comes into play. Second, U.S. cost-imposing strategists need to know how cost affects the outcome of Soviet decisions. For example, is cost perceived like a switch which results in simple go/no go decisions? Or is the impact of cost more subtle; e.g., changing the technology mix of weapons systems in order to retain important weapons programs, but to do so within resource limitations?

It is equally important for the cost-imposing strategist to know if Soviet decision-makers disregard cost in selecting future weapons systems (as is sometimes alleged by Western observers). If this were true (which we doubt), then the U.S. could easily drive Soviet leaders into making bad cost-effectiveness decisions *vis à vis* U.S. initiatives. However, if cost is important in the Soviet weapons acquisition process, some cost-imposing strategies should be more difficult to implement successfully.

Despite the apparent importance of understanding how cost functions in the Soviet decision process, one must recognize that this understanding is not an end in itself. That is, this understanding functions like a tool in helping the cost-imposing strategist craft a better initiative. For this reason, the issue of how cost plays in the Soviet process warrants more attention than it receives.

² *Ibid.*, p. 2.

B. COST EFFECTIVENESS AT THE MARGIN

The DoD Authorization Act of 1986 states that a strategic defense system may be deployed only if it is cost effective at the margin. That is,

the system is cost effective at the margin to the extent that the system is able to maintain its effectiveness against the offense at less cost than it would take to develop offensive countermeasures and proliferate the ballistic missiles necessary to overcome it;...³

At first blush, this problem seems a rather straightforward one of comparing the price of Soviet countermeasure options against the estimated price of targeted strategic defense systems. Viewed that way, "cost" becomes the key word in the expression "cost effectiveness at the margin." In that light, effectiveness is a function of cost at best, and is synonymous with lowest price at worst. Such an approach also assumes a universal economic rationality which is common both to market economies and to centrally planned economies.

There is, however, an alternative to the method just described--one which emphasizes effectiveness rather than cost. (Indeed, cost or price is seen merely as a subset of the analysis.) This alternative stresses the importance of evaluating the relative value of options given that each side has differing comparative economic advantages.⁴

If one goes down this second road, it becomes crucial to understand how cost functions as a decisionmaking factor for the Soviet leadership since it implies an understanding of how they view comparative economic advantage in particular situations. This, in turn, offers considerable insight into the relative attractiveness of particular countermeasures to U.S. strategic defense concepts and systems. On the other hand, if one sees cost effectiveness at the margin a merely a pricing exercise, then how the Soviets view cost in the weapons acquisition process is irrelevant.

At present, the issue of cost effectiveness at the margin is confined to strategic defense systems. However, this could well change in the future as Congress becomes increasingly concerned about how to get "the most bang for the buck" out of scarce U.S.

³ "Department of Defense Authorization Act, 1986," *Conference Report*, The Committee of Conference, 99th Congress, 1st Session, Report 99-235, July 29, 1985, p. 33.

⁴ For a fuller discussion of different ways of assessing cost effectiveness at the margin, see "Studying Cost Effectiveness at the Margin," a memorandum from Andrew W. Hull to Barry Leven and Robert Kranc of the Strategic Defense Initiative Organization, November 10, 1987.

defense resources for all proposed DoD systems. Consequently, understanding how cost effects the Soviet decision process could also become more important.

C. COSTING THE SOVIET THREAT

Every U.S. weapons program must define the threat for the out years. And, as part of this exercise, analysts often seek to project Soviet costs as a way of assessing the potential attractiveness of various threat options for the Soviets. Implicitly, such analysis assumes there is a correlation between analytically defined affordability and what the Soviets will ultimately do.

Unfortunately, costing the Soviet threat often means simply pricing its individual components. At other times, analysts will go on to argue the affordability of some course of action based on dollar/ruble estimates for the proposed threat program versus a set of economic assumptions grounded in a universalist view of economic rationality. That is, Western analysts tend to project Western market economic assumptions on to Soviet decisionmakers through mirror imaging. This results in the view that the problem is one of understanding how the Soviets deal with scarcity in the most rational economic fashion.⁵ Here universalist notions like marginalism, continuity, and economic optimization are applied in a *Homo oeconomicus* fashion.⁶

Such views miss the point. Centrally administered economies base resource allocation on political choices about priority undertakings. Consequently, resources may well be "misallocated" in a purely economic sense. That being the case, analysts worrying about the affordability of specific threat packages may draw the wrong conclusion because of their emphasis on the economic rather than the political aspect of Soviet decision-making.

This is not the same as saying that Soviet decisionmakers take a "blank check" approach to dealing with defense allocations. Instead, it suggests that the Soviets may be willing to bear a marginally higher economic burden (as defined in terms of percentage of gross national product devoted to defense) than one would expect to be economically rational. Also, it may mean a willingness to cut back on economically more efficient

⁵ Lee D. Badgett, "Defeated by a Maze: The Soviet Economy and Its Defense-Industrial Sector," RAND, N2644-NA, October, 1988, pp. 5-6.

⁶ *Ibid.*, p. 6.

weapons programs in order to finance higher priority, economically less sensible undertakings.

Understanding where and how cost plays as a decision factor in the Soviet weapons acquisition process is critical. This is doubly true when those costing the threat base their analysis on western economic assumptions and models. The resulting analyses may be able to price Soviet options well but lack sufficient sensitivity to the strong influence of politics on economic decisionmaking in a centrally administered economy. Consequently, analysts focusing on economics alone may be ill-prepared to estimate the outcome of Soviet decisions. For these reasons, better threat definition should result from leavening traditional costing/pricing techniques with insights about how "cost" decisions are shaped by conditions and priorities unique to the Soviet Union.

D. FINAL OBSERVATIONS

The foregoing discussion suggests several things. First, there is a need for understanding how cost functions in the Soviet decisionmaking process. This is especially true for U.S. examinations of potential cost-imposing strategies, assessments of cost effectiveness at the margin, and costing the Soviet threat. In each case, however, understanding the role of cost in Soviet decisional calculus is not an end in itself, but rather a means to another goal. Consequently, it may not always be clear to potential beneficiaries that they should take the intermediate step of studying cost as a decisionmaking factor. Nevertheless, we believe that doing so is important and so the necessary educational spade work ought to be undertaken.

III. RESULTS OF THE PRELIMINARY LITERATURE SEARCH

The search for data relevant to the questions raised in the previous chapter involved three separate approaches. First, the authors conducted preliminary searches of several computerized data services for monographs, émigré literature, analytic reports, and original Soviet source material. These were scanned for information about key Soviet organizations which were likely to play in the decisionmaking process, about functional topics related to cost, and for historical incidents where cost seemed to shape Soviet decisions about cost. Additionally, the authors examined the holdings of a number of regional libraries (e.g., the IDA Library, the SDIO Library, the Pentagon Library) for similar material. Lastly, the authors exploited their personal files for relevant items.

These searches were necessarily narrow in scope because of limited project funding. Nevertheless, a useful body of data was uncovered. (See Appendices A and B for a complete listing of authors and material.) This information was grouped into several general themes, all of which address the issues raised in the previous chapter. These themes were:

- level of decisionmaking and type of decisionmakers;
- type of decisions;
- nature of decisions;
- impact of concern over cost for the outcome of decisions;
- role of different actors in estimating costs, approving expenditures of resources, and monitoring the subsequent implementation.

Before turning to the specific content of each topic, some general observations are in order. First, it is worth noting that the Soviets write frequently about estimating costs for particular military and civilian products, as well as about the place of these estimates in the research, development, and procurement process. They also write about the importance of assessing costs in their decision process. However, they write very little about precisely who uses cost information to actually make decisions. For such information, it is necessary to turn either to émigré literature or to western analysis. Most of the émigré

literature is very specific; e.g., "we were able to get funding for X, but not Y." Unfortunately, as few of the émigrés have been from the higher-level decisionmaking organizations (Jan Sejna, a Czech official, is an exception), their information sheds relatively little direct light on how the decision was reached or who was responsible for making it.⁷ These questions are better addressed by using reports of Western analysis, which run the quality spectrum of being unburdened by data to using the best available intelligence information. U.S. intelligence sources provide information on programs which have reached the highest levels, but whose development may have been cancelled, selected, accelerated, or slowed because of cost issues. Unfortunately, the most detailed information of this sort is likely to be highly classified.

A. THE LEVEL OF DECISIONMAKING AND DECISIONMAKERS

Cost is relevant at every level of decisionmaking in the Soviet hierarchy, but its impact and the level of aggregation may be different. At the highest levels, such as the Politburo and the Defense Council, the focus is likely to be on major programs and highly aggregated costs (see, for example, the discussion by Sejna). One interesting question at this level is how the information is presented: are there ruble costs attached, or is the information in the form of resources and materials required as a fraction of the totals available?

The information that is available tends to focus on the decisions themselves, with costs discussed in only general terms; e.g., the shift to rocketry in part because they are cheaper and more capable than aircraft under Khrushchev and the scrapping of a number of ships at the same time or the development of new, presumably more cost-effective RD&A systems under Brezhnev.

Primary sources are almost non-existent on these issues at this level, especially for the contemporary era. The sources that are available include:

- Khrushchev's two-volume memoir (although we are told that the original material at Columbia University contains much more than appears in the published works [see Evangelista, *Innovation*, p. 80]);
- Aircraft designer A.S. Yakovlev's memoirs, in which he apparently discusses his involvement in a Defense Council meeting and Brezhnev's emphasis on reducing costs by minimizing variety;

⁷ Information on how costs and cost-issues influence proposals and low-level decisions is discussed in greater detail in Almquist and Heginbotham's IDA Memorandum Report M-470 (in publication).

- Jan Sejna's discussion of the high-level decisionmaking system in Czechoslovakia in the late 1960s.

Three valuable secondary sources (for each level) are:

- Arthur J. Alexander's 1978 Adelphi Paper, *Decision-Making in Soviet Weapon Procurement*;
- David Holloway's *The Soviet Union and the Arms Race*;
- Steve Meyer's *Economic Constraints in Soviet Decision-Making*.

The latter, in particular, attempts to distinguish the impact and role of three different levels of decisionmaking: the senior leadership, the ministry level, and the services.

These same issues arise in discussions at the next level: the Central Committee Secretariat, the Central Committee, the Council of Ministers, the Military Industrial Commission (VPK), the State Planning Committee (Gosplan), the State Committee for Material and Technical Supply (Gossnab), and the State Committee on Prices (Goskomtsen). This level is geared towards resolving and implementing the same types of issues made above.

Again, primary sources are scarce. Those that are available include:

- Brezhnev's memoirs of his time as Party secretary for defense industry in *Novyy Mir*;
- Kushnirsky's memoirs of working in a Gosplan institute;
- Faygin's memoirs of working in Goskomtsen;
- Friedzon's memoirs of working in several positions involved with economic oversight.

Valuable secondary sources include:

- Nolting's studies of Soviet research and development;
- A number of RAND studies of the Soviet defense industries (such as those by Abe Becker and Arthur Alexander), most of which focus on this level.

Below this level are the Ministry of Defense, the General Staff, the services, and the defense industrial ministries.

Primary sources for the role and concerns of the military include:

- Memoirs by designers and biographies of them, which, in the case of P.O. Sukhoi, describe his dealings with the military and their interests in cost vs. performance;

- Sejna's discussions of decisionmaking in Czechoslovakia in the late 1960s;
- The Delphic monographs, which frequently refer to dealings between industry and the military and discussions over costs;
- The BDM monographs, especially those of Igor Genis on the Voenpred system;
- Several articles in the Soviet General Staff journal *Military Thought*;
- The discussions of costs in the *Soviet Military Encyclopedia*;
- Several books on cost-effectiveness and systems analysis produced by Soviet military writers in the late 1960s and 1970s;
- Recent discussions in the Soviet press about conversion of defense industries to civilian.

Secondary sources on military interests in cost issues are very few, and include the Rand studies on civil-military relations and the debate over resource allocation and Holloway's paper for the Joint Economic Committee. There are very few studies of the Soviet military's mechanisms for dealing with cost-related issues at other than the most general levels.

Primary sources on defense industry include:

- The series of monographs from Delphic Associates (most focus on the next level down, but the interaction between the two is a frequent topic of concern);
- The BDM monographs;
- The spate of recent Soviet articles on conversion and previous articles by Soviet defense industrial officials;
- The literature by and about the weapons designers, in which their relations with industrial officials is regularly described.

Finally, the role of costs at the plant and design bureau levels are dealt with in a number of sources:

- Delphic monographs;
- The BDM monographs, especially those by Genis;
- The recent "round-table" discussion of defense plant managers in *Moskovskaya Pravda*.

The overall picture presented from these sources is one in which the military presents requirements and the designers present new ideas. Each set of actors is conscious of his own costs, but perhaps unable or unwilling to recognize the importance of costs to

the other. Designers create weapons with Soviet production capabilities in mind, keeping costs low, and they pad their proposed budgets to ensure that the expected cuts will not be too onerous. The military may be less cost conscious, but it is not clear how costs are levied upon it for weapons acquisition. The political leadership decides how much can be spent in satisfying military requirements and/or exploiting new technical possibilities, while the military and industry bargain over how to design and produce the resulting equipment and its ultimate *price* to the military. (The difference between a weapon's price and cost is outside the scope of this brief overview.)

B. TYPES OF DECISIONS

The second issue in evaluating costs that must be considered is the different types of decisions which are influenced. There are relatively straightforward technical decisions, in which two equally effective items have different costs. When the effectiveness varies, of course, the problem becomes more complex, and one has to ask how the Soviets evaluate effectiveness and its importance. A third variable that comes into play in such decisions is the time factor. Soviet sources note that decisions require the juggling of cost, effectiveness, and time, and that the balance is contingent on circumstances: cost and effectiveness are generally the two most important, but under conditions of dire threat, for example, time may come to dominate cost, and resources may be "unrestricted." In addition, the Soviets note that the effectiveness of a weapon system, which may never see combat, is difficult to evaluate. [See in particular Sarkisyan's works.]

In order to estimate Soviet weapons costs from a Soviet perspective, western analysts might use Soviet "cost-estimating relationships," or CERs. Several Soviet CERs have been published, and examples are included in the study of the shipbuilding industry by N.P. Lyubushin, the discussions of aircraft engines and aircraft in Sarkisyan and Starik's book on the aircraft industry, and for rockets and missiles in Mishin's book on their design. Using such CERs with increasingly available Soviet data on both weapons and costs should provide information about choices the Soviets may have made historically, as well as providing insights into Soviet perspectives on the relative costs of technology, labor, etc.

A second set of trade-offs involves the natural desire of the Soviets to play to their economic strengths. While technology may provide a relatively inexpensive alternative to manpower in the United States, the roles may be reversed in the Soviet Union. As a result, a decision to produce a relatively cheap engine which requires replacement every 250 hours

may be cheaper than the development of a more complex engine which lasts 2500 hours. Similarly, the approach selected by the Soviets (to remove the engine and return it to a factory for servicing) may be a cheaper solution than training hundreds or thousands of technicians to service the engines on-site (Soviet conscripts are paid only 7 rubles per month).

While these are mainly technical decisions, the Soviets also have other choices to make. How a system is employed and its role in Soviet operational art, strategy or doctrine can be influenced by costs: the emphasis on missiles of the late 1950s and 1960s was driven in part by the promise of lower costs and greater cost-effectiveness than was the case for aircraft. This point was made repeatedly by Khrushchev and various weapons designers at the time. Unfortunately, it is difficult to find specific details linking missions, operations, and costs, although the Soviets regularly have written about the theme in general. (See the discussions in *Military Thought*, Makeyev's article in *Morskoy sbornik*, and the book by V'yunenkov, Makeyev, and Skugarev.)

Information on these choices includes, of course, the raw data of the choices themselves: the engines, tanks, or rockets that make up the Soviet armed forces are the clearest indicators of the choices and priorities of Soviet weapons designers, builders, and the services.

Primary sources for these decisions vary by level, as suggested above. Technical choices are frequently made at the lowest levels, while the broad changes are made at the highest. An important point to recall, however, is that a higher authority can intercede in the decisions of its subordinates, and there have often been incentives for lower organizations to "bump" decisions upstairs, rather than take responsibility. Thus, the type of decision is not always a good indicator of the level, just as level is not always a good indicator of type.

Information on technical decisions is relatively abundant in the plant and designer level material and also in many analyses of Soviet weapons developments. The latter frequently discuss the technical options available to the Soviets, alternatives explored, and suggest the reasons for choices made.

Information on strategic decisions, that is, decisions which are designed to achieve general policy objectives, is more difficult to obtain, but there are general discussions in, for example, the writings of Marshal Ogarkov or Marshal Akhromeyev's pointed

announcement to the General Staff that the Soviet military would be procuring less in the immediate future.

C. THE NATURE OF THE DECISION OPTIONS

In addition to the level of decisionmaking and the type of decisions which are made, there is also the question of the nature of cost's impact on decisions. Is there a consistent way in which cost influences decisions and the Soviet military? Are there rules that the Soviets consistently apply, such as always buy the option which is the cheapest in the short term or do they prefer to make long-term investments in systems which, while expensive in the short run, may mean considerable savings in the future? Are there consistent patterns of the impact of cost based on decision-level or type, and does its importance vary with the organization? Finally, how has concern over cost been reflected in the non-procurement or design decisions which have been made? Ustinov's appointment as Minister of Defense, the establishment of the Unified System of Design Documentation (YeSKD), the apparent decision in the early 1970s to emphasize "reverse engineering" and reliance on non-Soviet technology, and the apparent leveling off of procurement growth rates all reflect the cost concerns of the leadership and their efforts to impose such concerns on the military, but each is very different from the other.

A related issue is the ability of the military to transfer funds from one military account to another. Can funds (or other resources) be transferred between operations and maintenance, procurement, training, etc? There is little information available on this, with the exception of Steve Meyer's interview with Shabanov, but information should be available from the intelligence community on this issue. Western analysts frequently discuss the shift of resources from, for example, aircraft to missiles, but can resources be moved so easily? Or is the Five-Year Plan so rigid (as some claim) that such shifts can only take place at five-year periods? Even then, Soviet acquisition programs may be budgeted for more than a single Five-Year Plan, so it is reasonable to ask how difficult is it to scale back a program that has, in theory, been budgeted for a multi-plan period? (The 15- and 20-year plans are generally more flexible.)

Finally, there are opportunity costs that cannot be captured accurately or effectively in a narrow definition of costs.

D. THE IMPACT OF CONCERN OVER COSTS

If the Soviets acknowledge that costs are important, it is just as important to recognize that the impact of concern over costs may vary. Thus, a country can consistently tackle new technology in its efforts to reduce costs and/or increase effectiveness, or (as the Soviets appear to do) continually rely on old, trusted technology whenever possible, using new technology very selectively.

The impact will also vary by level, and much of the discussion of the impact of costs by level is also a discussion of these different types of impact: the political leadership may choose to rely on foreign technology, while the designers and plant managers may push variants of existing capabilities, all in an effort to keep costs low.

E. WHO IS CONCERNED ABOUT COSTS AND HOW THEY ARE MEASURED?

A final set of questions, again similar to the level of analysis issue raised above, is that of who actually undertakes the analysis of different cost issues. For example, political leadership and its representatives up and down the system (the Party apparatus, for example) may be concerned only about absolute costs, while the military may be concerned more about the imposed constraints of being overly cost-attentive. Designers and plant officials have to reconcile the resources that are being made available to them with the demands, and it is their responsibility to provide the initial cost estimates which are, presumably, used by decisionmakers in reaching conclusions.

F. FINAL OBSERVATIONS

Soviet and western sources provide a hodgepodge of information about how the Soviets measure and use costs in making weapons decisions; no single source provides comprehensive overview, and understanding must be based on assembling data from disparate sources. In Soviet, émigré, and intelligence sources, information exists about how costs are evaluated and the role costs play in the decision process.

There is also an increasing openness about costs in the Soviet literature. For example, the Soviet press has reported that the cost of the boosters used to launch the "Soyuz" space capsules is 2-3 million rubles, the Soyuz itself about 7-8 million rubles, the Phobos space probes about R25 million each, and the military space program some 3.9 billion rubles per year. The cost of the roll-on/roll-off ships produced at the Zhdanov

shipyard is R35-39 million, the Su-25 Frogfoot aircraft is R5.8 million. and an hour's flight time in a Mi-8 helicopter is R530. Such information was seldom published even a few years ago.

Costs play different roles at different levels of decisionmaking. In *technical* choices, that is, those requiring a simple decision between two alternative technical solutions to a problem, cost can play a decisive role: of two equally capable systems, the cheaper is the preferable. Of course, "cheaper" is not easy to define. A product may be cheap, but have a short life (as in aircraft engines). This may be perfectly reasonable given the expected battlefield life of the equipment and the relative low cost of the manpower to entire engines. On the other hand, a single piece may be expensive, but lead to savings over time because its use in operation is significantly less expensive. Thus, technical decisions are not clear-cut decisions.

There are also decisions of a different sort: those revolving around strategy, operational art, and tactics. Cost plays a role in these as well, but perhaps of a different sort. In these cases, the issue is between a number of different solutions, perhaps spread across different services and organizations. Discussions of the impact of costs on how to accomplish strategic objectives is more difficult to find. These would include, for example, the choice made in the 1950s to emphasize missiles over aircraft, in part because they were perceived as less expensive.

It would also be valuable to differentiate between decisions to invest in defense and decisions to procure specific hardware. Soviet perspectives on long-term gains and the impact of those decisions on spending and thinking is, however, difficult to determine.

It would also be useful to link decisions with particular planning points. Specific decisions are made at specific points, and by understanding where those decisions are made in the process (before or after, for example, cost estimates) we should be able to get a better handle on the role of costs. This is becoming increasingly possible as the Soviets reveal more about the development of current weapons systems such as the Su-25 Frogfoot, the Su-27 Flanker, and the MiG-29 Fulcrum aircraft.

IV. CONCLUSIONS

The Department of Defense currently has three major areas of interest that benefit from knowledge about the role of costs in Soviet decisionmaking: (1) cost-imposing strategies; (2) cost effectiveness at the margin, and (3) costing the Soviet threat. We have found a number of sources that offer meaningful insights on those issues, including reports by Soviet émigrés, official Soviet journals, memoirs by Soviet leaders and officials, intelligence reports, and western academic studies. Also, the new Soviet openness in general, coupled with Mikhail Gorbachev's increasing concern about the shape and scope of Soviet defense spending in particular, promise more comprehensive insights than were ever available before.

Besides the three main questions raised in Chapter II, our reading of available literature reveals a number of subsidiary issues which could shed light on the principal concerns of DoD. These include:

- Differentiation of decisions to invest in defense in general versus decisions to procure specific pieces of hardware.
- The impact of cost on the content of Soviet strategy, operational art, and tactics.
- Linkages of decisions with particular economic planning points. In other words, are specific decisions made at particular points in the Soviet planning process? If so, our understanding of the impact of cost on specific weapons choices would be greatly enhanced.
- Systematic analysis of Soviet cost-estimating relationships would provide insight into how Soviets make cost trade-offs in developing and procuring weapons.
- How (if at all) do Soviet perceptions of U.S. weapons costs and their comparison to estimated Soviet costs affect the outcome of the Soviet weapons procurement process?
- A focused study on the interaction of Soviet weapons procurement and arms control communities could yield significant insights into how (and to what extent) Soviet defense burden influences Soviet arms control negotiating behavior and positions.

- With current Soviet interest in converting defense industries to non-military activities, understanding the transferability of Soviet defense resources would provide insights into how readily the Soviets can convert from defense to non-defense investment.

Finally, we again emphasize there are indeed significant questions that should (and do) concern DoD officials about how cost functions in the Soviet weapons acquisition process. Moreover, our limited literature survey indicates there are enough data already available to shed meaningful insights on those DoD interests.

APPENDIX A--
BIBLIOGRAPHY*

* A brief bibliography of classified references, "Appendix B: Bibliography of Classified References," is available separately.

APPENDIX A-- BIBLIOGRAPHY

Alexander, Arthur J., *Soviet Science and Weapons Acquisition*, Rand Report R-2942-NAS, Rand Corp., Santa Monica, CA, August, 1982.

Alexander, Arthur J., *Decision-making in Soviet Weapon Procurement*, Adelphi Papers Nos. 147/148, IISS, London, 1978.

Alexander, Arthur J., *Design to Price from the Perspective of the United States, France, and the Soviet Union*, Rand Paper P-4967, Rand Corp., Santa Monica, CA, February 1973.

Alexander, Arthur J., *Soviet Weapons Acquisition in A Period of New Economic Realities*, Rand Paper P-7489, Rand Corp., Santa Monica, CA, October 1988, .

Almquist, Peter, and Eric Heginbotham, *Soviet Perspectives on Weapons Costs*, Institute for Defense Analyses, IDA Memorandum Report M-470, in publication.

Anureyev, I., "Mathematical Methods in Military Affairs," *Military Thought*, No. 9, 1966, pp. 46-61.

Anureyev, I. and A. Tatarchenko, *Primeneniye matematicheskikh metodov v voyennom dele*, Voenizdat, Moscow, 1967.

Avramchuk and S. Bartenev, "Economic Substantiation of Military Equipment Policy," *Morskoy Sbornik*, No. 3, 1969.

Badgett, Lee D., *Defeated by the Maze: The Soviet Economy and Its Defense Industrial Sector*, Rand Note N-2644-NA, Rand Corp., Santa Monica, CA, October 1988.

Bartenev, S.A., *Ekonoicheskoye protivborstvo voyne*, Voenizdat, Moscow, 1986.

Becker, Abraham S., *Economic Factors Affecting Soviet Foreign and Defense Policy: A Summary Outline*, Rand Paper P-7148, Rand Corp., Santa Monica, CA, October 1985.

Becker, Abraham S., *Gorbachev's Complaint and Gorbachev's Dilemmas: The Soviet Defense Budget and Party-Military Conflict*, Rand Report R-3541-AF, Santa Monica, CA, Rand, December 1987.

Becker, Abraham S., *Guns, Butter, and Tools: Trade-offs in Soviet Resource Allocation*, Rand Paper P-6816, Santa Monica, CA, Rand, October 1982.

Becker, Abraham S., *Soviet Central Decisionmaking and Economic Growth: A Summing Up*, Rand Report R-3349-AF, Rand Corp., Santa Monica, CA, January, 1986.

Burov, V. and L. Khudyakov, "Razvitiye metodov issledovatel'skogo proyektirovaniya korabley," *Morskoy sbornik*, No. 10, 1985, pp. 66-70.

Central Intelligence Agency, "A Guide to Monetary Measures of Soviet Defense Activities," CIA, Washington, DC, 1987.

Chaiko, Lev, *Helicopter Construction in the USSR*, Delphic Associates, Falls Church, VA, 1985.

Checinski, Michael, "The Costs of Armament Production and the Profitability of Armament Exports in COMECON Countries," Research Paper No. 10, The Hebrew University of Jerusalem, Jerusalem, 1974.

Checinski, Michael, "The Economics of Defense in the USSR," *Survey*, Vol. 29, No. 1, Spring, 1985), pp. 59-78. [Mostly a historical survey.]

Checinski, Michael, "The Military-Industrial Complex in the USSR: Its Influence on R&D and Industrial Planning and on International Trade," *Stiftung Wissenschaft und Politik*, September, 1981.

Checinski, Michael, *A Comparison of the Polish and Soviet Armaments Decisionmaking Systems*, Rand Report R-2662-AF, Rand Corp., Santa Monica, CA, January 1981.

Cherednichenko, M., "Military Strategy and Military Technology," *Military Thought*, No. 4, 1973, pp. 47-60.

Chuyev, Yu.V., *Issledovaniye operatsiy v voyennom dele*, Voenizdat, Moscow, 1970.

Doe, Frank, "Understanding the Soviet View of Military Expenditures," in Joint Economic Committee (see below).

Evangelista, Matthew, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies*, Cornell, Ithaca, N.Y., 1988. (See especially pp. 46+, 68+.)

Evangelista, Matthew A., "Why the Soviets Buy the Weapons They Do," *World Politics*, Vol. XXXVI, No. 4, July 1984, pp. 597-618.

Fedoseyev, Anatol, "Design in Soviet Military R&D: The Case of Radar research in Vacuum Electronics," *Papers on Soviet Science and Technology* #8, Harvard University Russian Research Center, Cambridge, MA, May 1983.

Fedoseyev, A, *Zapadnya: chelovek i sotsializm*, 2nd edition, Posev, Frankfurt, 1979.

Fewtrell, David, *The Soviet Economic Crisis: Prospects for the Military and the Consumer*, Adelphi Paper No. 186, IISS, London, 1983.

Feygin, Bella, *The Theory and Practice of Price Formation in the USSR*, Delphic Associates, Falls Church, VA, 1983.

Firdman, Henry Eric, *Decision-Making in the Soviet Microelectronics Industry: The Leningrad Design Bureau: A Case Study*, Delphic Associates, Falls Church, VA, 1985.

Gelman, Harry, *The Brezhnev Politburo and the Decline of Detente*, Cornell, Ithaca, N.Y., 1984.

Genis, Igor, *The Work of the 3896th Military Representative Group at the Riga (Latvia) Electric Machine Building Plant*, BDM Corp., McLean, VA, 1981.

[Genis, Igor,] *The Role of the Military Representatives in the Soviet Defense Industry--A Case Study of the 3896th Military Representative Group (MRG) in Riga.*, BDM Corp., McLean, VA, 1981.

Girshman, Mark, *The Lvov Production Technical Complex of the USSR Ministry of the Radio Industry*, BDM Corp., McLean, VA, 1981.

Glagolev, Igor S., "The Soviet Decision-Making Process in Arms Control Negotiations," *Orbis*, Vol. 22, No. 4, Winter 1978, pp. 767-776.

Greenberg, Karl, *The Central Materials Research Institute of the Soviet Ministry of Defense Industry*, Delphic Associates, Falls Church, VA, 1986.

Hanson, Philip, *Soviet Industrial Espionage: Some New Information*, Royal Institute of International Affairs, London, 1987.

Holloway, David, "Economics and the Soviet Weapons Acquisition Process," in Joint Economic Committee (see below).

Holloway, David, "Technology and Political Decision in Soviet Armament Policy," *Journal of Peace Research*, No. 4, 1974, pp. 257-279.

Holloway, David, *Technology, Management, and the Soviet Military Establishment*, Adelphi Papers No. 76, IISS, London, 1971.

Holloway, David, *The Soviet Union and the Arms Race*, Yale, New Haven, CT, 1983.

Ioffe, Moisey, *Observations on the Baltic Shipbuilding Plant, Leningrad and Other Areas*, BDM Corp., McLean, VA, 1981.

Joint Economic Committee, *Soviet Military Economic Relations*, GPO, Washington, 1983. [esp. Holloway (pp. 16-52) and Doe (pp. 158-179)].

Jacobson, Roy Steven, *Design Philosophy and Functional Performance of Soviet Weapons: Exploring the Deterrence, Arms Control and Arms Transfer Implications*, Unpublished dissertation, Duke University, 1981.

Jones, Ellen, "Soviet Military R&D Policymaking," Paper presented at the Conference on Soviet Decisionmaking for National Security, 14-16 August 1980. [esp. pp. 42-50].

Kalerin, B., "Economic Criterion in Research on the Effectiveness of Armament," *Military Thought*, August 1965.

Khrushchev, Nikita, *Khrushchev Remembers and Khrushchev Remembers: The Last Testament.*, Little, Brown, Boston, MA, 1974.

Korniienko, A., and V. Korolev, "Economic Aspects of Soviet Military Doctrine," *Military Thought*, No. 7, 1967, pp. 28-37.

Kozlov, V., "The 24th Congress of the CPSU and Pressing Problems of Soviet Military Organizational Development," *Military Thought*, No. 6, 1972, pp. 16-28.

Kushnirsky, Fyodor I., *Soviet Economic Planning, 1965-1980*, Westview, Boulder, CO, Westview, 1982.

Kushnirsky, F.I., *Estimation of Real Growth and Productivity in the Soviet Machine-Building and Metalworking Sector: The Effects on Economic and Military Capabilities*, Delphic Associates, Falls Church, VA, 1986.

"Lectures from the Voroshilov General Staff Academy," *The Journal of Soviet Military Studies*, Vol. 1, No. 1, April 1988, pp. 29-53.

Leitenberg, Milton, "The Counterpart of Defense Industry Conversion in the United States: The USSR Economy, Defense Industry, and Military Expenditure," *Journal of Peace Research*, Vol. 26, No. 3, 1979, pp. 263-277.

Lyubushin, N.P., *The Cost Effectiveness of Design Decisions in Constructing Ships' Hulls*, DTIC Translation of *Ekonomicheskaya effektivnost' proyektnykh resheniy v sudokorpussostroyenii*, Sudostroyeniye, Leningrad, 1982.

Makeyev, B., "Nekotoryye vzglyady na teoriyu voozuzheniya VMF" ["Some Views on the Theory of Armaments of the Navy"], *Morskoy sbornik*, No. 4, 1982, pp. 27-31, at p. 28.

Makiyev, Yu.D. and K.A. Nikolayev, "Taktiko-tekhniko-ekonomicheskii analiz," *Sovetskaya voyennaya entsiklopediya*, Vol. 7, Voenizdat, Moscow, 1980, pp. 635-636.

Meyer, Stephen M., *Economic Constraints in Soviet Decision-Making*, Center for International Studies, Cambridge, MA, 1989.

Mishin, V.P., ed., *Osnovy proyektirovaniya letatel'nykh apparatov (transportnyye sistemy)*, Mashinostroyeniye, Moscow, 1985.

Muzychenko, A., "Comprehensively Develop the Theory of Military Economics," *Military Thought*, No. 8, 1971, pp. 63-67. [also co-author of SVE article on "Mobilization"]

Navrozov, Lev, "Some Invalid Criticism of the CIA Merits Dunces Cap," *New York City Tribune*, July 22, 1987.

Nishchenko, P., *Organizatsiya i planirovaniye deyatel'nosti otraslevykh NII i KB v priborostroyenii*, Mashinostroyeniye, Moscow, 1986.

Noulting, Louvan, "The Planning of Research, Development, and Innovation in the USSR," Foreign Economic Report No. 14, U.S. Department of Commerce, July 1978.

Novikov, V.G., and K.D. Konovalenko, eds., *Organizatsiya i planirovaniye radiotekhnicheskogo proizvodstva*, Vyshcha Shkola, Khar'kov, 1984.

Ofer, Gur, *The Relative Efficiency of Military Research and Development in the Soviet Union: A Systems Approach*, Rand Report R-2522-AF, Rand Corp., Santa Monica, CA, November 1980.

"On the Question of the Role of Economics in Nuclear Warfare," *Military Thought*, No. 11, 1965, pp. 25-39.

Organizatsiya i planirovaniye deyatel'nosti otraslevykh NII i KB v priborostroyenii, Mashinostroyeniye, Moscow, 1986.

Parkhomenko, A., "Problems of Management in the Area of the Development of Armament and Military Materiel," *Military Thought*, No. 9, 1966, pp. 62-73.

Parkhomenko, A., "The Analysis of Armaments Systems," *Military Thought*, No. 1, 1968, pp. 33-42.

Petukhov, P.M. and L.S. Postnova, *Ekonomika sudostroitel'noy promyshlennosti*, Sudostroyeniye, Leningrad, 1984.

Pew, Robert M., "Modeling the Soviet Weapon Acquisition Process," SAIC-85/6070&FSRC, 8 May 1985.

"Positive Experience of Foreign Countries," *Le Monde*, March 30, 1985, p. 8, translated in Foreign Broadcast Information Service-Western Europe (FBIS-WE), April 3, 1986, pp. K1-K2.

Povaliy, M., "Military Strategy and Economics," *Military Thought*, No. 4, 1971, pp. 29-43.

Pozharov, A.I., *Ekonomicheskiye osnovy oboronnoy mogushchestva sotsialisticheskogo gosudarsva.*, Voenizdat, Moscow, 1981.

Rognedin, I., "Reliability of Weapons Systems," *Military Thought*, No. 7, 1967, pp. 38-47.

Sadykiewicz, Michael, "Soviet Military Politics," *Survey*, vol. 26, No. 1, Winter 1982, pp. 180-210.

Sarkisian, S.A. and Ye.S. Minayev, *Ekonomicheskaya otsen'ka letatel'nykh apparatov*, Mashinostroyeniye, Moscow, 1972.

Sarkisian, S.A. and D.E. Starik, *Ekonomika aviatsionnoy promyshlennosti*, 2nd edition, Moscow, Vysshaya shkola, 1985. First edition also available as *Economy of the Aircraft Industry*, FTD translation FTD-ID(RS)T-0692-81.

Semenov, G., and V. Prokhorov, "Scientific-Technical Progress and Some Questions of Strategy," *Military Thought*, No. 2, 1969, pp. 23-32.

Solnyshkov, Yu.S., "The Military-Economic Basis of Tasks," *Military Thought*, No. 9, 1971, pp. 74-78.

Solnyshkov, Yu.S., *Optimizatsiya vybora vooruzheniya*, Voenizdat, Moscow, 1968. Also available *Optimization of Armament Selection*, FTD translation FTD-MT-24-201-69.

Solnyshkov, Yu.S., "Quantitative Evaluation of Possible Decisions Under Conditions of Uncertainty," *Military Thought*, No. 2, 1973, pp. 43-58.

Steinhaus, Alexander, *The Beginnings of Soviet Military Electronics, 1948-1961: A Personal Account*, Delphic Associates, Falls Church, VA, 1986.

Strode, Rebecca, "The Soviet Armed Forces: Adaptation to Resource Scarcity," *The Washington Quarterly*, Spring, 1986, pp. 55-69.

Tarakanov, K.V., L.A. Ovcharov, and A.N. Tyryshkin, *Analiticheskiye metody issledovaniya sistem*, Sovetskaya Radio, Moscow, 1974. Also available as *Analytical Methods of the Study of Systems*, FTD translation FTD-ID(RS)T-1202-79.

Tarakanov, K.V., *Matematika i vooruzhenaya bor'ba*, Voenizdat, Moscow, 1974. Also available as *Mathematics and Armed Combat*, FTD translation FTD-ID(RS)-T-0577-79.

"Taktiko-tekhniko ekonomicheskoye obosnovaniye," ("Tactical-technical Economic Validation"), *Sovetskaya voyennaya entsiklopediya*, Vol. 7, Voenizdat, Moscow, 1980, p. 636.

Trushin, B., and M. Gladkov, "The Economic Foundation of the Military-Technical Policy of a Country," *Military Thought*, No. 12, 1968, pp. 23-38.

Tsygankov, I.S., "Stoimost' vooruzheniya" [Cost of Armament], *Sovetskaya voyennaya entsiklopediya*, Vol. 7, p. 543.

Turetsky, Mikhail, *The Introduction of Missile Systems into the Soviet Navy (1945-1962)*, Delphic Associates, Falls Church, VA, 1983.

Valenta, Jiri, and William Potter, *Soviet Decisionmaking for National Security*, George Allen & Unwin, London, 1984.

Vestman, O.A. and Yu.N. Shvarev, "Voyenno-ekonomicheskiy analiz, ego zadachi i osnovnyye printsipy," *Morskoy sbornik*, No. 5, 1966, pp. 28-32.

V'yunenko, N.P., B.N. Makeyev, and V.D. Skugarev, *Voyenno-Morskoy Flot: Rol', perspektivy razvitiya, ispol'zovaniye*, Voenizdat, Moscow, 1988. [esp. pp. 60-89; note also p. 86]

White House, The, "A Study of Soviet Science," December, 1985, p. 13.

Yanov, Alexander, *Detente After Brezhnev: The Domestic Roots of Soviet Foreign Policy*, Institute of International Studies, University of California, Berkeley, 1977.

Yershov, Yu.V. and T.I. Shchedrina, "The Selection of the Most Promising Alternatives for Research and Development Projects," *Materialy po naukovedeniyu*, No. 10, 1969, pp. 14-26. Translated as FSTC-HT-23-0819-73.

Yevsikov, Victor, *Re-Entry Technology and the Soviet Space Program (Some Personal Observations)*, Delphic Associates, Falls Church, VA, December, 1982.

Zeleski, Eugene, "R&D: Planning and Financing," *Survey*, Vol. 23, No. 2, Spring 1977-1978, pp. 16-38.