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QUALITATIVE CONSTRAINTS ON CONVENTIONAL ARMAMENTS: AN EMERGING ISSUE. SUMMARY REPORT

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Qualitative Constraints on Conventional Armaments: An Emerging Issue
Summary Report

S. J. Dudzinsky, Jr., and James Digby

A report prepared for

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PREFACE

This Summary Report was prepared for the Military Affairs Bureau of the United States Arms Control and Disarmament Agency. It presents in concise form, the results of an initial exploration of the question of whether or not qualitative constraints on conventional armaments are desirable, feasible, and acceptable ways of promoting United States national security objectives in the long run. The emphasis is on the arms control implications of new precision-guided munitions (PGMs) and remotely piloted vehicles (RPVs), including both the difficulties and opportunities presented by the rapid development of a wide variety of such weapons.

This summary has been written to serve officials in the Arms Control and Disarmament Agency, the Department of State, and the Department of Defense, for whom it collects ideas and data on new weapons systems and suggests analytic approaches for dealing with possible qualitative constraints. It should also be of interest to the academic community, since it suggests research on an improved analytic method and theoretical constructs. The full results of the study are presented in *Qualitative Constraints on Conventional Armaments: An Emerging Issue*, The Rand Corporation, R-1957-ACDA, July 1976.

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SUMMARY REPORT

This report is concerned with the question of whether or not qualitative constraints on conventional armaments are desirable, feasible, and acceptable ways of promoting United States national security objectives in the long run. The discussion is centered around possible U.S.-SU agreements and emphasizes the arms control implications of the new generation of conventional arms, which includes precision-guided munitions (PGMs) and remotely piloted vehicles (RPVs). Our theme is that a better understanding of how the new generation of arms works, what sorts of postures are likely to be efficient, and how these postures relate to the needs of the two sides can help us to identify aspects of the competition where curbs on arms growth will be *mutually* beneficial. Limitations founded only on shallow understandings of these weapons, or that turn out to provide one-sided advantages, can have only a transitory effect, and the process of recovery could lead to even more dangerous instabilities.

We believe that the topic treated is timely. The past several years have seen many new weapons introduced into practical use that are qualitatively different, notably in their precision, whereas many of the more traditional weapon types are escalating in cost and are becoming, at the same time, more vulnerable. Moreover, consideration of the build-up of new arms in the United States and Soviet Union may shed light on the build-ups of some increasingly powerful arsenals in other countries.

INCREASING IMPORTANCE OF THE CONVENTIONAL BALANCE

In recent years, those concerned with arms control have mostly centered their attention on the strategic nuclear competition between the United States and the Soviet Union. But now that strategic parity has become a fact, it has become much more important to consider the balance of nonnuclear forces between the superpowers. Three reasons why it is more important to consider this nonnuclear balance can be noted. First of all, it is less feasible to use American nuclear superiority to deter aggression. Second, the great build-up of nonnuclear forces by the Soviet Union has strained U.S. relations with some of its allies. Third, it is increasingly perceived that the greatest nuclear danger may be a nonnuclear war getting out of hand, and this in turn might come from an instability in the balance of conventional forces.

It is not only important to consider the balance of conventional arms, but it is necessary to pay increased attention to their limitation and how certain types may enhance or degrade stability. This can best be done if considerable background is available on the mechanics of the new weapons, how well they work against the more traditional weapons, and the costs of the main classes.

Because the literature on conventional arms control is not very extensive, we have tried (in the body of this report) to provide reference data and to suggest sources. Missile ranges and accuracies are given numerically wherever possible, and both investment and operating costs are given for many weapons. The report also includes excerpts from several sources that give data on conventional arms or provide concise information on the factors needed for analysis.

INCENTIVES FOR CONSTRAINTS; SOME TYPES OF CONSTRAINTS

In the context of the arms competition between the United States and the Soviet Union, there are several incentives for attempting constraints on conventional weapons. These include:

- The enhancement of the security of the two parties and their allies.
- The prospects for economies, measured in terms of resources saved.
- The elimination of catastrophic instabilities.

The present research is primarily concerned with "qualitative constraints," which are defined as

> constraints that would limit the development, testing, production, or operational deployment of weapons systems that fit into an agreed-upon performance category.

But we recognize that in virtually any qualitative limitation there will be inherent quantitative aspects or implications, and the reverse will normally also be true.

Under the terms of this project, our research did not include an examination of limitations on nuclear weapons, strategic systems, chemical and biological weapons, and "exotic" systems, such as laser beam weapons. Dual-purpose weapons that could deliver either nuclear or nonnuclear weapons, however, were included. We considered explicit as well as implicit agreements, and, in fact, we believe that the explicit form, in which formal negotiations involve legalistic arguments over the exact wording of written agreements, might often be less suited to the interests of the United States than an implicit understanding. It would appear that the Soviets are more able, given their system, to treat loosely the constraints imposed by agreed-upon language than is the United States. Thus the United States might do better with an implicit understanding, in which there are substantial communications between the parties, but minimal pettifoggery. A good goal is to seek out mutually beneficial constraints and develop a good understanding of their implications over the long run. These would preferably be constraints in which abrogation would clearly be against the interests of the abrogating party. (To illustrate, can arms control analysts find understandings that would be parallel to the rule that requires automobile drivers to stay to the right of the dividing line of a highway?) In many ways the new generation of arms may provide hope for new understandings. This is so both because they may be making older weapons obsolete and because they may be causing strategy and tactics to be revised toward a greater precision in military effects as well as in objectives sought and signals conveyed. These opportunities can be kept in mind while considering the properties of the new weapons, discussed below.

THE NEW WEAPONS AND THE TECHNOLOGY BEHIND THEM

Major changes are taking place in the capabilities of a number of classes of nonnuclear weapons. Some observers believe that these changes will transform the nature of conventional warfare, and that, a dozen or more years from now, many of the systems that have been mainstays since the beginning of World War II will be obsolescent. In particular, there have been developments in PGMs, in RPVs that can be launched from a variety of platforms, and in mobile air defense systems. New designs of efficient and hard-to-track cruise missiles can function as either PGMs or RPVs. This overlapping of designations suggests that some definitions would be useful. A PGM can be defined as

> a guided munition whose probability of making a direct hit on its target at full range (when unopposed) is greater than a half. According to the type of PGM, the target may be a tank, ship, radar, bridge, airplane, or other concentration of military value.

Note that this definition does not exclude precision-guided missiles of long range--even intercontinental range--but it does assume a mission ending in impact, with the munition generally guided all the way to impact.

An RPV is probably best defined in a very simple way:

> A vehicle that is piloted from a remote location by a person who has available much of the same piloting information that he would have if he were on board.

Although a variety of PGMs and RPVs are under development in both the United States and the Soviet Union, a present-day appraisal would show that actual numbers procured (at least by the United States), for all but three or four types, is quite small. Thus, while major changes in conventional warfare are implied, it is well to keep in mind that they are potential changes, not changes already in hand.

The new systems have been particularly facilitated by three technical developments:

1. The use, in practical systems, of electromagnetic transmitters and receivers operating at much higher frequencies than those used in the past; among other things, this leads to an improvement in angular resolution that makes guidance systems more accurate.

2. Continued development of microelectronic circuits (notably LSI--large-scale integrated circuits) that permit highly complex signal-processing and storage functions to take place in small, reliable, and relatively rugged devices.
3. The development of highly efficient warheads that have great destructive potential but are light in weight.

These technical developments, used in concert, have already resulted in some military hardware with capabilities unheard of in the recent past. For example, the development of practical airborne lasers that use frequencies so high--i.e., wavelengths so short--that they are typically just below the spectrum of visible light has made it possible to guide weapons with angular accuracies approaching those of a high-powered rifle. When the signals reflected from a laser-generated spot that an individual has pointed at a target are processed by microelectronic circuitry, a very compact and effective guidance system can be used to steer a missile to within a few feet of a target from a launch distance on the order of 10 mi. It is just this combination that is being used in the new laser-guided Maverick antitank weapon system. But Maverick carries a very heavy warhead for its task, about 130 lb, and the whole round weighs about 460 lb. If the third development cited above, namely, new efficient designs for small high-explosive warheads, had been incorporated in this design, a missile with adequate lethality against tanks, but significantly lighter in weight, could have been built.

On the other hand, there have been major increases in the cost of a number of other weapon systems--especially those systems that have multiple functions and are an integral, interwoven part of high-performance vehicles intended for use directly in the arena of combat. These include deep-penetration fighter-bombers, new tanks, and nuclear-powered aircraft carriers. The latest models of some of these weapons systems, though very capable, cost a great deal more than the systems they were designed to replace.

Even as procurement costs for these traditional weapons systems have risen, so have the costs of manpower. The average cost per man in the American forces has increased from $3350 in 1955 to $11,000 in 1975. Thus it is important to look for ways of introducing qualitatively improved equipment to increase the productivity of each man.

IMPLICATIONS OF THE NEW PRECISION WEAPONS

It is important that those concerned with arms limitations consider the implications of the new technology of precision guidance. Here we give only a capsule treatment. Perhaps the essential statement about this class of weapon is this:

> Accuracy is no longer a strong function of range; if a target can be acquired and followed during the required aiming process, it can usually be hit. For many targets hitting is equivalent to destroying.

Notice, though, that even this brief statement implies that a number of things can go wrong. For one, the process of target acquisition may not be easy. Even for targets that are acquired, it may be difficult to track the target with presently deployed equipments, most of which use visual or near-visual wavelengths. Bad weather, battlefield smoke, camouflage, or other obscurants may prevent tracking at any but very short ranges. In some cases, efficient employment depends on a good command-control system, and some current systems are better known for their deficiencies than for their virtues. An opponent can take countermeasures against the PGM or its crew--some technical in nature and some tactical, such as evasion by the target during the missile's flight or attacks on the PGM while it is trying to guide the missile.

These chances for poor performance should be kept in mind while considering the following characteristics of PGMs and RPVs:

- Many PGMs and RPVs, when used under proper conditions, appear to have a much greater military effectiveness than earlier systems (even when compared with quite expensive alternatives that do not use precision guidance). However, there are some situations in which their effectiveness is limited--and those should be faced squarely.

- Many PGMs and RPVs are relatively cheap--cheap to develop, to procure, and to operate. But to understand the full cost implications, the context of their place in the posture and the circumstances of use is needed.
- Many of these new weapons could be developed and manufactured using the facilities and production methods available in most developed countries. Others, which may be very useful, require advanced industrial facilities.
- There may be important consequences for logistics deriving from the small size but great effectiveness of the new weapons.
- Many of the new types of weapons could be moved quickly and in quantity to the places where they are needed most--if there were means at hand to move them.
- Many of the present PGMs and RPVs are particularly useful to the side that is, at the tactical level, on the defense. In a decade or so, new generations of PGMs and RPVs (particularly of longer range) will be well-suited for offensive tactics.
- Even the largest PGMs and RPVs (e.g., the sea-launched cruise missile) can be hard to detect and their carriers can be effectively disguised. They can be launched from a wide variety of platforms without affecting terminal accuracy. The era of relying on aerial and space reconnaissance for verification of agreements may be coming to a close.
- There are important political consequences stemming from the new weapons. They will be able to destroy many military targets that formerly required nuclear weapons, with less collateral damage to civil targets. Thus the nuclear threshold may be raised.

From the point of view of arms limitations, these implications lead us to speculate that

> PGMs and RPVs may provide the impetus to arrive at qualitative constraints on larger, and more complex and costly weapons systems.

If it can be demonstrated that advantages of some of the major offensive weapons are likely to be offset by PGMs, then nations might be more willing to slow the introduction of these major weapons into their forces or even to phase out existing equipments that have a high cost of upkeep.

A second possibility for arms control may be equally important. The fact that the accuracy of precision weapons and their relatively small warheads can lead to less collateral damage opens up the opportunity for agreements, or implicit understandings, that would strictly limit civilian damage in a conventional conflict. Abiding by such an undertaking may be an efficient way for military forces to operate, as they did for hundreds of years, as well as being morally attractive and mutually beneficial to both adversaries.

DECIDING ABOUT CONSTRAINTS

Decisions about qualitative constraints will depend on the answers to questions at several levels: (1) What are candidate systems for agreement or understanding? (2) What are the incentives for the United States (and for the Soviet Union) for a particular agreement? (3) Do qualitative constraints seem useful to pursue as a general class?

By and large, these questions can be addressed in terms of three criteria: desirability, feasibility, and acceptability. Here desirability refers to an objective and analytical evaluation of the net incentives for agreement, whereas acceptability refers to whether or not the agreement is politically palatable. Feasibility refers to the ability to monitor, inspect, and ensure compliance with the agreed-upon terms. An agreement or understanding, to endure, must continue to meet all three criteria from the viewpoint of both parties: it must be desirable *and* feasible *and* acceptable.

Our research suggests that a heuristic approach is likely to be useful for so complicated an evaluation. In other words, hypotheses about the consequences of possible constraints would be constructed and then tested and retested. Our research has suggested three approaches for testing hypothesized constraints. The first is to break down the three criteria into a number of subcriteria; in other words, to use a systematic and detailed checklist approach. The second approach is to paint a picture of land, sea, air, and space warfare of 15 to 20 years from now in an attempt to identify weapon systems that will not be needed by that time or that will be needed only in small numbers for special purposes. These systems might be good candidates for qualitative constraints. However, there is a complicating factor in this approach: because of new developments, otherwise outmoded systems just might be useful longer than envisioned. For example, the B-52 with air-launched cruise missiles may remain effective much longer than B-52s alone, and carrier-based aircraft with standoff launch capability may serve very effectively compared to deep-penetration aircraft.

The third approach involves (a) constructing models of future U.S.-Soviet confrontations, both with and without the constraints being studied, and (b) posing a series of test questions to determine the impact of the postulated constraints. Actually, all of these approaches need to be considered simultaneously. All are quite rudimentary; we have made no major contributions to analytical technique.

Throughout these evaluations, one of the most important tasks of analysts will be to identify limitations that might foreclose systems whose value cannot be known until later.

WORKING WITH ASYMMETRIES

While the complexities of decisions to constrain conventional arms, and the difficulties of evaluating proposals, may result in some suggestions for exactly symmetrical arms limitations by the two superpowers, we believe that the most promising direction lies elsewhere. To get the greatest value--as rated by the value systems of each side--any agreement or understanding will probably have to be asymmetrical.

The military balance between the United States and the Soviet Union has always been characterized by asymmetries--aspects that reflect different value systems on the two sides. America has generally been well ahead of the Soviet Union in advanced technology, especially relative to offensive forces at sea or in the air, whereas the Soviets have maintained larger land forces and more extensive antiaircraft and coastal defenses.

Many of these asymmetries have been a natural product of geography and history, and each side has opportunities and problems conferred by its geographic position. For example, the Soviet Navy--with minor exceptions--operates from home ports separated from the open oceans by narrow seas and straits, and until recently they have neglected the long-endurance bluewater ships that the U.S. Navy emphasizes. The United States, on the other hand, has been forced by its location to develop ways of transporting military forces and their supplies over great distances, and has much more highly developed air and sea transport systems. (Although still true, this is an area where the Soviets have shown great improvement, as evidenced by their performance during the Arab-Israeli War of October 1973.) In addition, each side's history (its good and bad experiences) has affected its present-day practices.

It is important to recognize these asymmetries and the openings they may provide for qualitative constraints in conventional armaments. For example, since the Soviet Union does not currently build large aircraft carriers, it would not be productive to seek a symmetrical agreement in this area. On the other hand, past Soviet postures have shown a grave concern over the threat from *our* aircraft carriers, so they may be willing to reduce the number of a given quality of attack submarines in exchange for our reducing the number of aircraft carriers that exceed certain performance characteristics.

The most restrictive form of qualitative constraint would prohibit the development, testing, production, and operational deployment of weapons systems that fit into an agreed-upon definition. However, a combination of qualitative and quantitative constraints, where the numbers of systems having certain qualities are not reduced to zero but rather to an agreed-upon quantity, is another possibility. Such constraints have several aspects that may enhance their acceptability to the United States. They could be applied at either the production or deployment level. From the U.S. point of view, such agreements would be less dependent on the exceedingly difficult verification of what is happening in Soviet laboratories or testing grounds. At the same time, the United States could carry qualitatively advanced weapons to the point of pilot production and depend on our relatively strong capabilities for mass production of the most recently developed weapons to save the day if it were found that the Soviets had abrogated the agreement--and if there were time. Moreover, such an agreement would at least achieve some of the economic benefits of limitation, especially the avoidance of large-scale procurement, maintenance, and manpower costs, and at the same time it would permit our industrial technology base to remain at the forefront of the relevant technologies. (However, because we typically spend 15 to 25 percent of total procurement funds prior to large-scale production, defense contractors would have to raise unit prices to stay in business.) In the United States, this kind of agreement might also be more acceptable from a political point of view, since plants would not be shut down.

In the course of recent debates on new military technology, Albert Wohlstetter has compared those who are now calling for severe restrictions on such development with the Luddites, the group in 19th century England who sought to hold back the industrial revolution by destroying machines. We believe such restrictions are often wrong for the United States; they can, in some cases, run against important aims of arms control. This is because new technology can sometimes lessen the resources going into arms. It may also permit a new precision in the physical aiming of weapons, which in turn permits a new precision in the purposes for which military forces are applied. New technologies can--potentially--make forces less vulnerable, more responsive to political control, and possibly less costly. In fact, the new technologies of precision guidance suggest that there may be a common ground between the political elements in the United States who have been identified as opposing larger defense expenditures and those whose main interests have been in the improvement of U.S. defenses.

Thus in seeking candidates for limitation among conventional arms systems over the *short and medium term*, it seems to us that it is particularly important to consider constraints on the large, penetrating weapons systems of traditional types (for the United States, these include, for example, the XM-1 tank, the CVN, and the F-111D), which are becoming both more expensive and in some cases more vulnerable to precision weapons. As a consequence, these generic types may become self-limiting. This may take 10 years or 30 years, but it seems likely if not inevitable. If so, why should ACDA bother to consider weapons in this category? First, a great deal of money might be saved by anticipating this trend, just as a great deal was saved during the life of the Washington and London Naval Treaties, which mainly confirmed the politically inevitable. Second, overall, there is uncertainty as to how the trend will go with time, tempered by the fact that the traditional systems can be the platforms for the most efficient modern weapons, whereas their vulnerabilities can be postponed through the suppression of their natural enemies. This points up the need for a careful analysis of penalties and benefits. But if ACDA is to do the doable, this seems to us the *immediate* area where agreements or understandings should be explored.

Over the *long term*, however, the arms control specialist must learn how to deal with the small and efficient modern weapons, a class that includes many weapons that will defy present detection techniques, that may exist in great numbers, and that can be employed with great effect. These are the weapons about which analysts need to learn more, for which limitations must be explored along new conceptual pathways, and which governments--ultimately--must control.