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Here at the Naval War College, in struggling to tie together our sessions on arms control and negotiation, we have finally settled on a simulation exercise. This game has proved to be a powerful synthesizer, and several players in various positions within Government and civilian academia have suggested we share this tool with others. Our purpose here is to describe the game in a manner so intriguing that our readers will want to use it.

Our clientele, the student body, consists of senior military officers from all services, civilians from defense-related Government agencies, and select naval officers from over 35 other countries; all highly qualified and experienced leaders in the national security policy field. To this clientele we attempt to portray the processes of arms control and negotiation as legitimate complements to other methods of providing for national security. We are speaking of strategies to be integrated with all other available courses of action leading to "deterrence," however defined. Our primary objective is to prompt our clients to contemplate their role in the arms control and negotiation processes: what contribution can these processes make to security, and what contribution can they make to the processes? As leaders in national security planning, our clients have no choice but to be involved and the issue becomes the quality of their advice.

Our principal aim is to concentrate on the rational end of the spectrum. Yet we are well aware that actual agreements are fused by an array of factors on both sides of the table, not the least of which is a complex interaction of organizational process and bureaucratic politics which often obscures rational analysis. For several years our teaching methods paralleled what we observed in actual negotiations, using past agreements and current proposals for case studies. Unfortunately, seminar discussions collapsed into counting drills. Further, those whose careers had been spent with various weapons

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systems quickly became advocates, and we were often mired in definitional issues. Although there was a certain value in having our clients experience the same frustrations as our negotiators, it did little to accomplish our overall objective—to build a framework for rational analysis. We needed to develop a teaching method that would leap beyond the bureaucratic abyss and focus on the central comparisons, which are:

- the relative contributions of U.S. weapons to U.S. national security strategy;
- the competitive nature of U.S. and Soviet strategies; and
- the possibility of a negotiated arms limitation between these two powers which would provide mutual security.

We attributed most of our difficulties to the static, comparative nature of our presentations. As the very process of negotiation is dynamic, we felt a simulation exercise would meet our objectives. We therefore set out to place our clients in the role of participants in the negotiation process, rather than critics. Given the myriad factors which could be "simulated," we sought simplicity through the following assumptions: each side will protect, in the bargaining process, those assets which they value most; and each side will attempt to eliminate from the other those systems which present the greatest risk. These two principles, and these alone, form the basis of the game.

We then built the simulation around the procedure a parent often uses when two children contest a single candy bar: one child divides the candy bar and the other chooses which half to have. In our game, the "candy bar" is your own set of nuclear forces which you yourself divide, and so divided, the other side selects the portion to be eliminated. More specifically, the participants are segregated into two teams, Red and Blue. Each side places a value on his own systems of up to a total value of 10,000 points at the start of the game. Then each side removes 1,000 points of the other's systems, based on that assigned point value. Afterward, each side revalues his remaining systems, this time at 1,000 fewer points, or 9,000 points for the second cycle. Again, each side removes 1,000 points worth of the other's systems. The procedure is repeated for five cycles. The end result is approximately a 50 percent reduction in armaments.[1]

With this procedure we have made operative our two assumptions. Each side's system values are expressed quantitatively by the points assigned to them; risk is reduced in succeeding increments of 1,000 points. Given this, neither side need insist on imposing its value structure or definitions on the other—nor *can* it, in actuality. Similarly excluded from planned play are the political and bureaucratic factors discussed earlier. It was not our intent to ignore those real pressures, but we did feel it was beyond our capability to simulate them in a meaningful manner. However, we did not preclude them from coming to bear if the participants brought these perspectives to the game.

The simulation, then, is built from simple but realistic assumptions. The assumptions, translated as value preservation and risk reduction, are, by construction, independent events. They are independent relative to the two sides' perceptions as well as within a single side. Although artificially segmented, procedurally, the iterative nature of the game forces integration of these two factors as well as many of the other interrelationships we wanted to explore—the crucial stimulus and integrator is the point system.[2] The result is a manageable and exciting teaching tool which may also lend itself to experimental design.

An Example Game

Let's take an example game, beginning with the same starting systems (shown at table 1) as were used in a developmental game played recently by a select group of scientists, engineers, and military officers, many of whom possessed extensive knowledge and experience in the arms control arena. We ask you to play the game and compare your results to those of the developmental game. Ideally, you would have a friend take the Red inventory and you take the Blue; however, if you are reading this by yourself, take the Blue side, but keep Red in mind. Now, what would be your strategy for five cycles of negotiations? What end position would you like to achieve? Is your goal a position of dominance or equality? Would you be a cooperative player or one trying to play the toughest possible game? Which systems would you value most? What strategy and mode of play do you think the Red side will adopt? Finally, based on what you consider to be Blue's national security objectives, assign the 10,000 points allocated for your systems in the first move. Remember, the Red team will remove 1,000 points from your arsenal based on your valuation. You'd better be careful.

Finished with your point scoring? Now let us ask you some questions:

- What did you decide on for your long-term strategy? Did you strive to preserve a balance of capability (i.e., the time-honored concept of the triad which maintains balance between the manned bomber, the land-based ICBM, and sea-based systems to buffer against technological breakthroughs which might negate any single system)? For those of you who preserved the triad, did you do it "because there are three of them"? Could you have preserved the air-breathing leg by valuing the SLCM higher?
- Again, concerning strategy, we shall assume that your overall objective includes some measure of stability. Does your valuation pattern square with your definition of stability? By the way, many specialists argue that stability involves eliminating the incentive for a first strike or reducing the vulnerability to a first strike. Are you preserving or eliminating these capabilities and vulnerabilities? Does your point valuation scheme indeed reflect your stated strategy?

List of Available Weapons Systems

Blue Systems

System	No. Systems	W/H per System	Total Warheads	Yield (MT) per W/H	CEP (feet)	Vulnerability/ Hardness*
MX	10	10	100	0.34	300	3,000
MM3A	300	3	900	0.33	600	3,000
MM3	250	3	750	0.17	600	3,000
MM2	450	1	450	1.20	2,000	3,000
Trident	384	8	3,072	0.10	1,400	inv.
Poseidon	256	10	2,560	0.04	1,400	inv.
ALCM***	2,400	1	2,400	0.20	300	a/inv.**
SLCM****	600	1	600	0.20	300	inv.
Totals	**4,650**		**10,832**			

Red Systems

System	No. Systems	W/H per System	Total Warheads	Yield (MT) per W/H	CEP (feet)	Vulnerability/ Hardness*
SS-17	150	4	600	0.50	1,200	5,000
SS-18	308	10	3,080	0.50	800	6,000
SS-19	360	6	2,160	0.55	1,200	7,000
SS-24	10	10	100	0.10	1,000	a/inv.**
SS-25	72	1	72	0.55	1,000	a/inv.
SS-N-8	292	1	292	1.00	4,500	inv.
SS-N-18	224	7	1,568	0.10	3,600	inv.
SS-N-20	80	8	640	0.10	1,700	inv.
SS-N-23	32	10	320	0.10	1,600	inv.
ALCM***	800	1	800	0.25	400	a/inv.
SLCM****	200	1	200	0.25	400	inv.
Totals	**2,528**		**9,832**			

Table 1

* Hardness figures are in psi.
** a/inv. denotes "almost invulnerable."
*** Air-Launched Cruise Missiles (ALCM) represent entire bomber force.
**** SLCM denotes Submarine-Launched Cruise Missile.

Source: International Institute for Strategic Studies, London, *The Military Balance 1986-1987* (Letchworth, England: Garden City Press, Ltd., 1986).

- How did you assign points: by delivery system or by the number of warheads available within that system category? Take a moment and calculate the number of points per warhead in your scheme. Do you have a points-per-warhead spread which is appropriate? For instance, does MX have a very high points-per-warhead ratio while something else is much lower? If so, then you will probably save these few MX warheads while losing a large number of something else. Next, did you value anything at zero? If you did, then Red will get it for free in the first round. Is that what you intended? Finally, do you have any system whose total is at or below 1,000 points? Can you afford to lose that entire capability in one round, or would you like to hedge against that possibility by increasing that system total to above 1,000? If you need to do that, then where would those extra points come from?

In our developmental game, Blue conducted a rousing debate among the players before adopting a strategy. Central issues of the debate were as follows:

- The stated goal was security from, and deterrence of, a Red attack. The question was, should that ultimate goal be pursued through dominance over Red, or would stability be sufficient to accomplish the objective?
- To what degree should the Blue advantage in undersea weapons be preserved? To what degree would you allow continued Red superiority in throw weight, i.e., SS-18, SS-19?
- Should the triad be preserved, or should total elimination be allowed for such systems as land-based ICBMs so long as there is a full complement of ICBMs at sea? Would not the elimination of Blue land-based ICBMs also mean that the powerful SS-18 would be without its prime targets?
- To what degree are the fundamentals of flexible response maintained through the remaining systems? Are smaller, controlled responses still feasible? Does this dictate preservation of single-warhead, hence older, systems? Does a decay in flexible response capability also dictate a shift toward fundamental, vice extended, deterrence?
- To what degree should the newer, more capable systems (such as Trident and MX) be valued over the older systems (such as Poseidon and Minuteman II)? What points-per-warhead ratios are appropriate? How cheaply can the older systems be given away?
- How does verification affect point valuation? What impact does that issue have on system priority?

A similar debate took place on the Red side, only from a different perspective as Red's view of stability was quite different from Blue's. After more than two hours of heated discussion, decisions were made on both sides and strategies adopted. The values chosen for both Red and Blue in our example game are shown at table 2. Note that Red opted to protect his powerful SS-18 missiles, his mobile missiles (SS-24 and SS-25) and SLCMs, but was willing to sacrifice most of his submarine-launched ballistic missiles (SS-Ns) and bomber forces (represented by ALCMs). Blue took a very balanced approach, spreading his points evenly among elements of the triad, but gave highest value to his more modern systems, such as MX (4 points per warhead) and Trident (1 point per warhead and more than 3,000 total points). How do these valuations differ from your game? Why do they differ?

Let's return to your game. Again place yourself as the Blue negotiator. Exchange lists if you have a friend playing Red; if not, then accept the Red evaluation at table 2 for the next step. Now, cut 1,000 points from Red's inventory. Which systems will you remove? Will you go after his hard target kill capability, his mobile missile systems, or his submarine-launched weapons? What are your priorities of removal and why? Are you going to

Initial Valuation

Red System	Value	Blue System	Value
SS-17	600	MX	400
SS-18	2,750	MM3A	1,000
SS-19	900	MM3	500
SS-24	900	MM2	225
SS-25	900	Trident	3,075
SS-N-8	600	Poseidon	1,480
SS-N-18	600	ALCM	2,400
SS-N-20	500	SLCM	920
SS-N-23	900		
ALCM	600		
SLCM	750		
Totals	**10,000**		**10,000**

Table 2

play the toughest possible game, assuming your opponent will also, or will you cover for his weaknesses in the interest of stability. In the process, try to figure out what Red was telling you through his evaluation. Can you assess his intentions? How does Red's valuation affect your strategy? How about Red's perception of a final position or definition of stability? Does it matter, or can you proceed and protect your own interests *without* appreciating Red's view?

The removal (or "destruction") phase of the example was again accompanied by a rousing debate. Red could see the high value assigned to MM3A but knew that it was the system with the greatest killing power. The MX was the most modern and most capable single system, but the low numbers of warheads made it of lesser significance. Poseidon, MM3, and MM2 looked like bargains, but those systems posed no real threat. Blue could see several great bargains, particularly in the SS-19, but was quite concerned about the threat caused by the SS-18. Finally, both sides reached a decision (see table 3).

Systems Removed in First Cycle

Red System	Removed	Points	Blue System	Removed	Points
SS-18	11	98	MM3A	300	1,000
SS-19	360	900			
ALCM	2	2			
Totals		**1,000**			**1,000**

Table 3

Red removed from Blue the system that threatened it most: the MM3A, despite the relatively high number of points per warhead assigned to it. Blue, in true capitalistic fashion, took advantage of bargain prices offered for the SS-19, eliminating this system, then used leftover points to remove a few SS-18s and ALCMs. What do you see in these strategies? Was Blue trying for stability or dominance? How does the first removal phase compare with that of your game? Why was Red willing to pay such a price for MM3A? Would

both sides be able to continue these strategies throughout the game, or would dire consequences result? How did this compare to your approach?

Now, let's get back to your game. Having cut Red's inventory, either have your partner cut your Blue forces by 1,000 points, or put on your Red hat and cut your own. If you have to do the latter, be devious and brutal, acting according to Red's interests as you envision them. Pass the results of this first round back, examine the results, and start again—this time with only 9,000 points to assign. Repeat this process five times following the rules we outlined earlier, and see where it takes you. Ask yourself the same questions in each round. When you finish the last cycle ask yourself: Have we created a better world as a result of our drawdown?

In our example game, both sides were consistent with their initial strategy implementations throughout the five cycles. Red placed his highest priority on the SS-18, mobile missiles, and a few submarine systems. Adapting to this valuation, Blue removed the remaining systems—largely submarine-launched missiles and ALCMs (generally agreed to be stabilizing systems)—which had to be offered cheaply. Blue placed higher and higher value on his land-based ICBMs, but Red continued to remove them virtually without regard for cost. Finally, suffering from a severe warhead disadvantage, Red evened the balance somewhat in the last cycle by removing some cheaper, less threatening systems such as Poseidon and SLCM. The end game condition is shown at table 4. Note that Red lost his bomber capability and most of his submarine force, but retained a substantial number of silo-based and mobile missiles. Blue lost most of his land-based missiles but retained most of his submarine force (all of the Trident) and about half of his bombers. Is this a good end position in your mind? Would you have permitted negotiations to reach that point? How did your game's end point differ from that in our example game?

Systems Remaining after Five Cycles

Soviet System	Number	Warheads	U.S. Systems	Number	Warheads
SS-18	98	980	MM3	55	165
SS-24	10	100	MM2	450	450
SS-25	72	72	Trident	384	3,072
SS-N-18	75	526	ALCM	1,137	1,137
SS-N-23	32	320			
SLCM	199	199			
Totals	**486**	**2,197**		**2,026**	**4,824**

Table 4

Have We Created a Better World?

To add richness to the game, we need to make some sort of assessment as to the success or failure of negotiations. To do this, we have developed a computer simulation which shows the trends in stability from cycle to cycle.

Although we are discussing in this example only the beginning and end points, this analysis is equally important at the end of each cycle; for, if at any point along the negotiating path the situation becomes unstable, then the side with a preponderant advantage may quit or, worst yet, use its advantage. To conduct a stability analysis, our model asks the very basic question: If one side were to launch a first strike could it reduce the other's retaliatory capability to the extent that it is no longer a credible deterrent? If the answer to the question is "yes," then we have crisis instability, as one side may be tempted to conduct a disarming first strike. If the answer is "no," then neither side can conduct a successful first strike, and we have crisis stability. We begin with a stable situation; however, during the course of a game, one or both sides may develop a first-strike potential or at least move dangerously close to that capability. If so, then we have created a world worse than the one from which we started.

It should be emphasized that during the course of the game our concept of stability and analysis is not foisted upon the players; rather, they are expected to develop their own model and live by it. Only during the postgame critique is our concept of stability defined and the analysis of game results compared with it. This is done to aid player analysis and generate discussion rather than to display "answers." Nevertheless, both Red and Blue developed concepts of stability which were generally consistent with ours, perceiving that vulnerable, accurate weapons with high yields were destabilizing, while invulnerable and less accurate weapons with lower yields were stabilizing. There was the notable exception of the ALCM (which, recall, represented all air-delivered systems). Red saw the ALCM as a negligible threat, believing it could be defeated either by existing Soviet air defenses or by launching before impact. Thus, Red felt that ALCM should not be viewed as a silo-based missile killer even though it had the accuracy and yield combination to be one. In contrast, our analysis was based on potential; hence, ALCM was considered a hard-target killer. Blue also viewed stability in this manner and, therefore, valued the system much higher than Red.

In line with this view, Red executed a strategy that was consistent with his view of stability. He emphasized removing the destabilizing Blue systems despite the extraordinarily high value placed upon them. In contrast, Blue was opportunistic, taking advantage of Red bargains, gobbling up warheads to gain an advantage. As a consequence, Blue gained a large warhead advantage and removed most of Red's submarines and air-delivered weapons, leaving Red with predominantly targetable systems. Even with the warhead advantage, Blue continued to bargain hunt, sweeping away warheads despite the dissonance of this action with the originally defined strategy. Thus, Blue retained a balanced, albeit reduced, triad of forces, the preponderance of which was untargetable. By the end of the game, Blue had achieved a significant advantage and was approaching a very threatening

position. As a consequence, although we had reduced the arsenals of both sides, we had actually created a less stable world. In response to this situation, Red would probably have to loosen release procedures, maintain a "launch on warning" alert status for his SS-18s, and keep his mobile missiles deployed and ready, ensuring Blue could not launch a disarming first strike. Our long-sought strategic arms reduction may, in effect, have created a worse situation than the one in which we started.

All the above analysis and discussion manifested during the course of the game and the critique afterward. As a consequence, the players saw the game as a powerful tool to focus on the proper questions and issues of nuclear arms reduction.

The Power of the Game

Just by reviewing this quick example, we can get a feel for why the game is a powerful teaching vehicle. The game is simple, yet complex. Play is interesting, intense, and fiercely competitive. Players are thrust into the world of strategic systems in a way that causes the trade-offs of various bargaining positions and negotiations strategies, the complex interactions among the various weapons, and the difficult issue of stability to come alive. Most interesting is that the game focuses discussion on the contribution each category of weapons makes to U.S. national security strategy, rather than on what the system is capable of on a narrow technical basis. The problem of advocacy we experienced previously, in seminar, literally disappears as the group is forced to assign points to all systems. We saw the same net effect in evaluating risk as each side sought to cut 1,000 points from the other. In short, the scope and sophistication of seminar discussion was raised dramatically.

We have seen Red and Blue participants become personally involved at a level approaching "real" negotiations. The "game" takes on the air of serious business and becomes highly competitive in a hurry. We have seen players refuse to break for lunch and continue a rather spirited discussion in the elevator on their way home. Not only is this a sign that the game is good, but it also means the players have internalized the objectives. Red and Blue teams generally pursue divergent strategies, as each has a different view of how the world should look. Each can proceed on his own course to accomplish his goals, applying a completely different perspective on the value of retaining or removing various systems. In fact, in every game we have played, *both* sides have been quite happy in the end, feeling they had achieved their objectives, but each wondered how the crazy bunch on the other side could look so happy after having lost so decisively.

Periodic "summit conferences" during the game permit each team to express to the other whatever thoughts or ideas seem pertinent. These are great opportunities for one side to gain an appreciation for the other side's

strategy, and to hear the other side's interpretation of one's own strategy. A detailed, postgame critique is also quite valuable. Each side presents its view of the game to the other, giving a frank appraisal of strategy from a Red and Blue angle. The controller portion of the game critique gives players the benefit of a stability analysis (they are not given this until *after* the game), giving an interpretation of each side's strategy and the impact of the implementation of the strategy on stability. These postgame conferences have been lively and stimulating, and greatly enhance the learning experience.

We believe we have a superb method for satisfying at least our own objectives for teaching about arms control and negotiations; moreover, we suspect it might be useful in at least the wider academic community. However, at least two general questions remain: Does this simulation actually portray a possible path for arms reductions? Assuming the game parallels reality, is this simulation useful beyond the instructional environment?

Concerning the former question, we are concerned that we have dismissed the political and organizational pressures that we know to exist. Although they come into play with expert participants, these factors are not always present; we do not make any effort to incorporate them consciously, nor do we provide any controls on this type of input. Our only conclusion in this matter is that the *rational* approach may present a centerline position about which actual negotiations might cluster. In defense of this conclusion we have found a reasonable consistency in Blue and Red paths, especially with more "expert" players. On the other hand, we lack proof that either Blue or Red is playing as they actually would in real negotiations.

The latter possibility, that this technique has utility beyond the academic community, is appealing. We were very fortunate to have had the assistance of experienced personnel from the Arms Control and Disarmament Agency (ACDA), the Pentagon (Office of Secretary of Defense, Joint Chiefs of Staff, Air Staff), the other war colleges, and the Department of Energy in developing this methodology as a teaching device. In the process, they have suggested that it might be useful as: an introductory exercise for negotiators and supporting staffs; an analytical tool to formulate negotiating positions; or, just possibly, a technique in the actual negotiations to communicate or probe for avenues of potential agreement. These uses seem to be logical extensions of the methodology and thereby quite feasible. But whether this format could be used in actual U.S.-Soviet negotiations is highly debatable.[3] However, the format of the game does eliminate the need for both sides to agree upon objectives or definitions. Since each can operate under different premises and values, and both sides, in our experience, seemed content up to the point of 50 percent reductions, it may actually be possible to adapt this simulation to the real world—as suggested by Dr. Garwin and discussed in

note 2. But that is being notably presumptuous on our part and undoubtedly reflects the personal bias and enthusiasm we have toward this product.[4]

In closing, we believe it is important to reiterate that we eschew claiming credit for the originality of this concept. Our contribution is that we have rolled the idea into a teaching strategy that may or may not have application elsewhere. It is powerful as an instructional device and we want to share it with others who might be interested. We encourage comments and suggestions on how to improve our methods. Our clients are among those who will offer the "expert advice" to our negotiators, and we take very seriously our charge to educate them well.

Notes

1. Our quantification scheme needs explaining. First, we selected 10,000 points as a starting position because each side is initially given approximately 10,000 warheads. Thus, 10,000 points averages to roughly one point per warhead—an easy concept to work with. Second, the number of points to be reduced and reassigned each time was set in order to minimize player bookkeeping. We reduced the number of points to be assigned by 1,000 each round so that players would not *have* to revalue each time, providing they kept the same valuation priorities. We therefore reduced by 1,000 points each time because that removed 5,000 points in five cycles, for 50 percent of the beginning arsenal point value; however, players must recognize that the percentage of the *remaining* arsenal removed each cycle increases from 10 percent in the first cycle to 20 percent in the final cycle. Any of these features may, of course, be changed. We found that by reducing the numerical manipulations the players have more time to focus on the "strategy" issues.

2. We do not claim this concept as original. In fact, the seed for the idea came from a speech on SDI at the Naval War College by Dr. Richard Garwin. He mentioned it as a somewhat humorous solution to the difficulties we have experienced in negotiations. We considered it from the perspective of teaching about the process. Nonetheless, we believe it is correct to give him the credit for being the stimulus. By the same token, others we may not know may have had or even published similar ideas. In fact, we refined the concept by examining a similar approach in the legal proceedings of divorce and estate settlements. The bottom line is that we will be glad to take credit for developing this idea as a teaching tool, but if there exists a parallel article which our literature search missed, then we yield any credit with no contest. Our purpose in publishing is to share the results—which we will do freely.

3. If this format were to be used in actual negotiations, then the simulation would have to entertain such factors as modernization and defenses. We incorporated both of these into our game. However, we found that it is important for new players to familiarize themselves with the "base game" before launching into the full game with modernization and defenses. In addition, we have no doubt that an exchange model of some sort would be necessary—again we have constructed such a model, but it is based on our own definition of stability, our own (open source) estimates of system performances, and only uses single-shot kill probabilities. We have excluded such parameters as prelaunch survival, en-route system survivability, and probability of target acquisition. By the same token, we treat defeuse as a simple liuear function. More elaborate exchange simulations are available and could be used in lieu of ours.

4. Dr. George Pitman of the Arms Control and Disarmament Agency, in a thorough critique provided during development, suggested an alternative structure. He stresses that negotiators historically have focused on the end state rather than the specific reduction process. Our structure clearly has the opposite focus and is oriented toward analyzing temporal stability; the game is therefore more "normative than heuristic" (Dr. Pitmau's words). To better approximate actual negotiations, yet preserve the learning techniques offered in our original structure, he suggested ". . . a better way to play the game would be to have each side take a fifty percent cut in each rouud. At the end of each round, each side would accept or reject the cuts made by the other side. If the cuts were accepted by each side, then the game would be over. If not, each side would reevaluate its systems and the game would continue. The objective of the game would be to reach an agreement within five rounds. If no agreement were reached in five rounds, the game would terminate with no agreement."