

**LONG SHADOWS AND VIRTUAL SWORDS:
MANAGING DEFENSE RESOURCES IN THE CHANGING
SECURITY ENVIRONMENT**

Ted Gold, Rich Wagner, January 1990

The remarkable events unfolding in the Soviet Union and in Eastern Europe inspire visions of a safer world: a future distinguished by enduring constructive and cooperative superpower relationships. There is much talk of drastically reduced defense needs and corresponding reductions in defense budgets. Unfortunately, there is considerably less discussion about the national security strategies appropriate to move us toward such visions, cope with the greater uncertainties we now face and guide our budget and force posture choices.

Our purpose here is to suggest a way of thinking about the emerging security environment and its effect on how our defense resources should be managed in these times of change, uncertainty and opportunity. We address certain defense related roles played by the nation's scientific, technological and industrial bases and focus particularly on the relationships among the defense system acquisition activities: research and development, requirements generation, production and deployment. We will contrast how these roles and relationships were thought about in the past with how they should be viewed in the future. We do not address the role of our scientific and technology bases in fostering industrial competition, which also has significant security implications.

President Bush has spoken of moving beyond the strategy of containment toward something better suited to the new political landscape. The associated military strategy –describing the purposes for military forces, how those forces should be postured, and how they would be used in war if needed –will have to be rethought as well.

A strategy for defense-related use of our national resources in general, and our scientific, technological and industrial base in particular, is a necessary complement to the political and military strategies. In the not too distant past, e.g., the World War II era, such resource strategies were considered to be the essence of security policy. They also played, prominent, roles in guiding our responses to the emerging Cold war and the attack on Korea in the early 1950s, and when Sputnik focused attention on technology later in that decade,

More recently, resource strategies have been less expressly a part of overall U.S. national security strategy. However, in spite of reduced status in our strategy hierarchy, the defense implications of relative East/West resource bases appear to have weighed heavily in Soviet thinking and influenced their recent decisions to move towards less confrontational postures. The resource components of defense strategy likely will become even more consequential in the future.

Our scientific, technological and industrial resources can help encourage and sustain improvements in the changing political and military relationships as well as provide hedges to cope with less benign futures. A strategy for their use will be especially important as the U.S. defense budget shrinks substantially below recent levels. Almost half of the budget is now used for R&D, production and related activities which support the defense base.

Adopting a resource strategy suited to the emerging security environment will require changes to the defense acquisition process which go beyond the procedural and organizational. A new vision of the basic roles and purposes of defense acquisition is needed. Furthermore, making these changes to support the new strategies will entail modifying the culture within which the defense acquisition process operates.

THE OLD VIEW: THE FUTURE MUCH LIKE THE PAST; THE DEFENSE ACQUISITION PROCESS AS A PIPELINE. For the past few decades, our defense planning was based, sometimes explicitly, on the view that, the future would be much like the recent past. The constant was an intensely competitive soviet union supporting its position with large standing forces and using those forces often enough so that the threat seemed always at hand. Another element in this unremitting threat picture was a Soviet defense acquisition process succinctly characterized by former Secretary of Defense Harold Brown: when we build, they build; when we stop, they build. This security environment helped foster a widely shared perspective (perhaps not shared by Brown) of the defense acquisition process as a pipeline. Research and development are poured into one end and eventually their fruits appear as fully deployed systems at the other end.

Certainly, the acquisition process must serve as an efficient pipeline to deliver needed systems to the field. However, there is a widespread tendency to view its pipeline role as the sole function of the acquisition process. This tendency appears to be as prevalent among insiders to the process as among the public. Thus, a common perception has been that the value of R&D ac-

crues only if and when fully deployed systems materialize. Funds expended on systems that did not reach deployment were often considered wasted; programs that did not proceed through production to deployment were considered failures. This perspective of the acquisition process as a pipeline, and only as a pipeline, has also distorted how the defense resource base itself, which supports the acquisition process, is viewed. However, there are substantial values and "productsn of R&D and of the technology and industrial base beyond providing deployed systems. For reasons and in ways we will discuss, these other values will become increasingly important in the emerging security environment.

THE LONG SHADOW EFFECT. What are these other mproductsw of defense resources and the acquisition process? R&D activities afford value in and of themselves before (and in many cases independent from) any production or deployment. They provide Knowledge: to support arms control and other policy decisions and to understand current and potential future threats. Further, a developed and demonstrated potential to produce or deploy certain systems is a product in its own right and can provide options and hedges against an unknown future and mitigate the consequences of surprise. Perhaps even more important, especially in the new environment, the potential of future deployment can influence possible adversaries' behavior: providing incentives for arms control, dissuading against cheating and breakout of treaties, convincing them, now or at some future time, that they would have nothing to gain from resuming a military build-up. In effect, the R&D casts a long shadow forward, its influence felt long before any deployment. Thomas Schelling used the term "long shadowm in the 1950s in reference to how the existence of nuclear weapons shaped views of the future. The effect we have in mind is similar, but applies to all research and development. One of the authors, along with Steve Rockwood and Jasper Welch of SAIC, sketched these more general long shadow effects in a 1988 paper. (Later we will address why these positive Influences are likely to outweigh possible negative "arms race" effects.)

Even though the pipeline image has dominated the acquisition process, there has always been a long shadow component of our security posture. Although it has often not been deliberately managed, it may have had a larger positive effect than is connionly understood. The Strategic Defense Initiative (SDI) –in generating knowledge, in developing options and in its impact on the Soviets –is a prime current example. There are others. There is evidence that the Soviets have been very concerned about Western prowess in smart

weapons and associated surveillance systems (a capability thus far more potential than real). More than a decade ago, the Soviets were apparently taken aback by the emerging U.S. capability for small, long-range cruise missiles. A somewhat perverse example is the U.S. ICBM program over the past 15 years, generally perceived as politically influenced and full of false starts and unfilled paths. A case can be made in retrospect that, although not the intent, the ICBM development program was a successful long shadow activity. It avoided very expensive large scale deployments, while doing enough R&D, demonstration, production and deployment to keep our options open and convince the Soviets that we would not allow them to gain usable superiority.

Despite these examples, insufficient attention has been paid to the long shadow role of defense-related RFD and of the technology and industrial bases. Most often the long shadow effects were not given much explicit weight, or were even deprecated, in the decision process. Representative was the remark made by former Defense Secretary Casper Weinberger on the fifth anniversary of SDI in March 1983: "We cannot defend our nation with a research program." But long shadow aspects of our defense postures, undervalued in the past, will be even more important in the future.

THE NEW VIEW: UNCERTAIN FUTURES, NEW OPPORTUNITIES. In contrast to the old assumption that the future would be much like the past, the future before us now is characterized by both greater opportunity and greater uncertainty. The need to cope with both will have profound effects on defense planning and acquisition. Instead of a single baseline future dominating defense planning and programming, we now must account for several plausible alternatives. Will Gorbachev succeed or fail? What are the consequences of either outcome? Are the Soviets playing for breathing room? Which of the recent changes are reversible rapidly? Which are more enduring? Will the lessening of Soviet control domestically and in Eastern Europe lead to instabilities which could have security implications? What are the implications of the expected rise of other significant military powers and the spread of advanced weapons?

The current defense acquisition process, dominated by its pipeline role and largely discounting other values, is not well suited to cope with the greater uncertainties we now face. Neither is it well suited to meet the needs deriving from the growing importance of arms control as an element in our security posture. verification and safeguard measures will play substantial roles in dealing with the risks associated with arms control agreements. Both

capabilities contribute to deterring noncompliance. safeguards also mitigate the consequences of cheating and treaty abrogation. Safeguards often will include maintaining capabilities –to develop, test, produce or deploy certain systems –as both a deterrent and a hedge.

Up to this point we have argued that, to cope with uncertainty and influence potential adversaries, the long shadow elements of the defense acquisition process will become more significant in the future. There is a more proactive course to coping with uncertainty than simply providing hedges, and a more positive tack to Influencing potential adversaries than dissuading particular developments or providing incentives for specific arms control measures. In addition to uncertainty, the present time provides hope and opportunity. We should take advantage of the opportunity to try to shape the evolution of the overall security relationship with the Soviet Union in desirable directions toward desirable ends. Over the next few years the U.S. and NATO will be searching for such collective visions to guide our strategies and programs. There is a natural and reinforcing correspondence between the long shadow aspects of the defense base and desirable evolution of the political and military relationship with the Soviet Union. To understand why, we will need to develop a view of how those relationships could be shaped to evolve in a desirable way. (The way of thinking about the emerging security environment that we will outline stems from a continuing effort involving Rodney McDaniel, Joel Resnick and Leon Sloss as well as the authors-)

A VISION OF THE EMERGING SECURITY ENVIRONMENT.

In a preferred path into the future, we would see continuing improvement in the Soviet Union's behavior and in the propitious aspects of the political changes in Eastern Europe. More important, we would see both become increasingly durable. Indeed, a fundamental descriptor of future security environments will be the durability of improvements in both the political and military relationships. Thus, over time we would see a decreasing likelihood of Soviet reversion to more confrontational behavior and restructuring to a more dangerous military posture.

Of particular importance to our resource strategy and its component acquisition process would be that, in this preferred future, the time required for such reversal would increase, as institutions in the Soviet Union and Eastern Europe which underlie durable improvements become more robust. The signs of reversal will be more visible as well. History suggests however, that as tensions decrease, our sensitivity to mark these signs will also decrease. Our strategy should be designed to reinforce durability of improvement, and

to both discourage reversals and cope with them should they occur. It may well be decades before we can be confident of enduring transformation of the Soviet Union.

Threats from third world countries will likely grow in relative importance as the immediacy of the Soviet threat recedes. (The intensity of so-called low intensity conflicts may not be so low given the growing proliferation of modern weaponry.) However, we believe that the Soviet Union, albeit posing potential dangers different than in the past, will continue to be the major driver of US defense budgets, postures and programs.

Increasingly durable improvements in the superpowers' political relationships might be manifested in the parties' defense postures as a sequence of changes over time, in how the military instrument is thought about and structured – changes fundamental enough to be called paradigm shifts. One thread linking these paradigm shifts would be increasing preparation time required to mount large scale offensive operations, from the days to weeks we have been concerned about, to several months and perhaps eventually to years.

The military paradigm of the past forty years, and still embodied in today's force postures, could be labeled as an "attack paradigm." It is characterized by large standing forces poised to attack or defend in days or weeks – the Soviet forces in particular equipped for offensive action. We already may be starting to move towards a "mobilization paradigm, with smaller standing forces, most of them less ready, with several months required to prepare for very large scale offensive action. An extension of this in the far future might be a "rearmament paradigm," with even smaller standing forces and (a few) years required to build equipment and mobilize the forces needed to mount, sizable offensive military operations. Along with these lengthening preparation times and smaller forces might come shifts toward forces with characteristics less suited to large scale offensive action (though, what this means in detail remains to be defined).

Such an evolution in forces seems natural since it would be consistent with likely trends toward longer times for the political relationships to deteriorate as we move into the future. It also seems desirable, although risks would remain. Longer times to prepare for war do not guarantee absence of war. Likewise, longer warning times do not ensure that we will heed the warning signs. There has always been considerable disagreement among Western observers as to how long it would take the Soviets and the Warsaw Pact

to prepare for attack. In the recent past, the uncertainty ranged from days to several weeks. If and as preparation times become longer in the future, there will continue to be a range of uncertainty. Dealing with such uncertainties will remain an inescapable responsibility of defense planning. We will need to avoid gross disparities in mobilization capabilities and address the possibility of asymmetrical mobilization between the West and the Soviets. The geographical asymmetries are obvious; societal asymmetries may not favor the Soviets as much as conventional wisdom has long held, and may be changing rapidly. In a rearmament paradigm the economic base could strongly favor the West, given timely response to indications. Nuclear weapons could also play a role in dissuading attempts to win mobilization races.

During the past few decades, nuclear forces also have been kept at high readiness states: poised for use. The high readiness posture of US nuclear forces stems from concern for their survival as well as their extended deterrence role of deterring non-nuclear war. We envision a continued war preventing role for nuclear weapons (a subject for another paper) although with considerably changed force structures and postures. As the immediacy of the conventional threat recedes and the political context improves it will be desirable to shift to nuclear force postures that are also much less poised for use than today's. However, nuclear forces do not lend themselves as naturally as conventional forces to substantial increases in the preparation time required for offensive use. It will be a formidable challenge to deal with the security and stability implications of these fundamental differences between preparation times of nuclear and conventional forces.

Throughout the evolution we have posited, the strategy for use of the industrial and technological base assumes greater importance relative to military strategy per se. In such a future, there would be both less concern for, and less dependence on, immediacy of the military instrument. Emphasizing the long-shadow effects and resource-related elements of our security strategy not only would be consistent with, but could reinforce, these trends. (It could be argued that the Soviets' new thinking and new behavior are based on considerations out of which if-would have been natural for them, in their thinking about security, to have developed also a long-term, defense-related resource strategy.)

THE GROWTH OF NON DEFENSE SUPPORTED R&D. Another element of the changing environment is a growing difference between what is technologically available and technologies actually embodied in de-

ployed force structure. This divergence was smallest at the end of World War II when practically everything that could be done in military technology was being done. The difference has steadily increased over the past forty years. A paper presented by Ashton B. Carter, Harvard University, offered that "...DoD R&D furnished one third of all the money spent on R&D in the western world in 1960. Today this fraction is one sixth." The fraction is likely to fall further as civil technology burgeons and military budgets shrink. The technological disparity can create destabilizing tensions which could partly counteract relaxation of political tension, if indeed such relaxation continues. On the other hand, most of the civil technology is born in the west. Thus the growing gap can enhance security and stability if we can adapt our defense base and acquisition system to deal more effectively with this opportunity.

VIRTUAL DEPLOYMENT & ARTIFICIAL EXPERIENCE. These trends –increased emphasis on strategies to deal with greater uncertainty, the shift, toward emphasis on mobilizable capability, and the growing technology gap –led to two concepts: "virtual deployments" and "artificial experience."

A "virtual deployment" is a capability brought to within some time before actual deployment –months to several years –and then put on hold to be maintained at that (or a time-varying) state of future deployability. ("virtual" is sometimes incorrectly used to mean "not quite". We use it here, instead, in the sense of Webster's definition; "existing or resulting in effect or essence though not in actual fact or form".) An array of virtual deployments could be in various stages of development, demonstration, prototyping or even limited production. The array of time delays (before actual full deployment) is what would be managed and adjusted. (Even today, this is probably how several nations think about and manage their nuclear proliferation R&D.) For the longest time delays, it is the deep technology base –for example, materials science –which is involved.

The virtual deployments would be used to "develop the board, lb as in chess, with one's own virtual deployments blocking or channeling a potential adversary's virtual deployments. The ensembles of actual and virtual deployments would have a complex deterring interplay. The "deterrenceinvolved would be not only deterrence of war, but. dissuasion of mobilizations or certain deployments (actual or perhaps virtual) as well. As we have said, this has been to some extent the case with, for instance, ballistic missile defense technology over the past couple of decades. In the future, military relationships/competitions, at least among the major powers, may be characterized

more by development and maintenance of such an array of undeployed options, than by deployed systems. With the growing technology disparity, and shrinking defense budgets, there are likely to be more of them than of actual deployments.

Some will question the arms race implications of increased emphasis on the long shadow model and virtual deployments, and of the tensions inherent in the civil/military technology disparity. The long shadow effect can work both ways; R&D can both stimulate and dissuade adversaries' developments. Properly managed, dissuasion can predominate. Much concern about arms races has tacitly assumed little resource constraint; but this has clearly been unwarranted, especially (we now believe) with regard to the Soviet Union, and it may be even less valid in the future. Further, the tensions associated with the inevitable civil/military technology gap are probably less worrisome with many technologies partly developed toward military systems and fewer deployed, than fifth more deployed and a great many totally undeveloped. Finally, better a virtual arms race than a real one.

Increased emphasis on virtual deployments and the growing disparity between civil technology and deployed military technology will magnify an existing trend: growing reliance on, and need for, "artificial experience." Heightened environmental concerns, tightening budgets and resource constraints have already motivated great interest in simulation technologies and capabilities. Indeed, deterrence –war avoidance –strategies in general lead to reliance on systems which are deployed, but not used in war, and thus have uncertain capabilities. The interactions of new technologies embedded in future forces, and of their counter-and counter-counter-measures, will not be well understood. Of course virtual deployments cannot be actually tested in war. High fidelity simulation and training techniques, used not only for deployed systems but to assess the interplays of potential developments and virtual deployments, will increasingly be the currency of military economy,

The Defense Advanced Research projects Agency's SIKMET program represents an important step in this direction, and is beginning to be used for "virtual prototyping, which could be a level of virtual deployment.

CHALLENGES OF INCORPORATING NEW APPROACHES INTO THE DEFENSE ACQUISITION PROCESS. The issues and concepts sketched briefly here may be on the way to becoming a new and fundamental strategic reality, which could have profound impact on how the Department of Defense does its business and even what it thinks its

responsibilities are. For example, industry now independently funds a lot of R&D up through prototyping, hoping to recoup this investment during production. This may not work very well today, and it can't work in a future consisting much more of virtual deployments. And the preoccupation, over the past decade, with cost-efficiency of the later phases of the acquisition cycle would have to shift to put much more emphasis on the earlier stages. The technology base would need a strategy developed with the same seriousness as applied today to strategies for use of forces in being. ("Competitive strategism might be thought of doing this, but it remains more rhetoric than strategy. It also doesn't give as much weight to long-shadow effects as we do here or address the deep tech base.)

To begin to move toward managing according to these emerging realities, we need to explore in more detail: 1) the increasing disparity between developing civil technology and deployed military (or demilitarized," but not deployed) technology –how to manage the disparity and its opportunities and potential instabilities; 2) the idea of a partial paradigm shift –how technology and R&D play with regard to mobilizable capability (there is a paucity of analytic tools for understanding competitive mobilization and mobilizability capability: this could be a serious weakness, especially if the Soviet Union does have a resource strategy); 3) advanced simulation, specifically in the context of these issues – i.e., to provide artificial experience to manage the technological disparity and virtual deployments; and 4) differences between the preparation times required to use nuclear and non-nuclear forces and the implications for deterrence and stability.

Adopting and implementing the proposed new approach will be difficult. There will be less funding available and thus intense competition for diminishing resources. Devotees of the pipeline model of acquisition will argue that cuts in force structure can be matched by corresponding cuts in R&D. Furthermore, it will require changes not only of the acquisition process but in the underlying culture as well.

The pipeline model of the acquisition process is embedded in the culture of much of the Pentagon and the rest of the military industrial complex. The major defense companies make their profits from large scale production; military officers earn promotions from moving programs through the next acquisition 'milestone.'" But to cite one example, in a long shadow strategy, many R&D programs will be deemed successful if they do not have to move to the next milestone. Some of these may have to be maintained for long periods of time. The current system of rewards and incentives is

not particularly compatible with this approach. Business as usual will not do. Even business as it is being changed in the current attempt to reform the acquisition process will not do. Both civilian defense managers and the military services will feel the stress.

Most of the recent attempts at Pentagon reform have been directed, explicitly or implicitly, at repairing the pipeline. The pipeline is indeed badly in need of repair; it is clogged if not leaking. The fundamental problems are not fraud, abuse and explicit waste. Much more significant has been inadequate requirements management. Over-requirement and over-specification have been endemic, stemming both from too much regulation (as much internal to the Pentagon as external) and frequent failure to perform comprehensive cost performance tradeoffs and other necessary ingredients of starting programs right, compounding the problem has been a general inability to modify performance requirements in subsequent development and production when the requirements too often turn out to be more difficult and expensive to achieve than expected. Disciplined requirements management will present even more of a challenge in these times of greater uncertainty about the future.

Not surprisingly, for it was written before the Berlin Wall came down, the generally excellent Defense Management Report to the President by Secretary of Defense Dick Cheney reflects a pipeline perspective of the acquisition process. Along with a frank assessment of deficiencies and on-target recommendations, the document emphasizes the importance of not starting more new programs than long-term resources available to DoD will support. It directs that this criterion be established at the step in DoD's formal acquisition process known as Milestone I, Concept Approval. Prior to Milestone 1 there will be "Concept Definition studies to evaluate potential alternative approaches to meeting validated priority needs." The document allows that since there is a need to address alternative approaches, "more Concept Definition studies may be undertaken than will be carried past, Milestone 1." Such flexibility is a step in the right direction but doesn't go nearly far enough.

In addition to addressing alternative solutions to validated needs, our defense acquisition process must also account, for alternative futures: futures in which the Soviets revert to dangerous confrontation, futures in which they progress toward liberal democratic values, futures in which we have little idea where they are heading, futures in which new threats emerge. There is an aggressive role for technology in the strategy we have outlined: not

only as insurance to hedge against uncertainty, but also as a tool to help shape events and influence the behavior of potential adversaries. We are not however, calling for unsupervised play by technologists. We envision a disciplined multitracked process.

Indeed, dealing with the new circumstances we have described in this paper ought to become a higher level of "validated need" to increasingly reflected in the formal acquisition process. This will require that some programs proceed past Milestone I, some through Milestone II (Full Scale Engineering Development) and sometimes beyond Milestone III into pilot production even when the probable outcome will not be full-scale deployment. All of this and much more will have to be taken into account in the needed strategy for the consolidation and restructuring of the defense resource base in the coming times.

This impending consolidation and restructuring can reinforce a new overall security strategy, or it can be counterproductive if it is simply allowed to happen or carried out according to premises inconsistent with the overall strategy. One of the latter outcomes is not out of the question, because there has been relatively little attention to resource strategy in recent years. A resources strategy and its component acquisition process which pay relatively less attention to the near term and more attention to the farther future will encompass more of the pervasive uncertainty and be more consistent with how we should be shaping our security relationships with potential adversaries. Doing this will require careful management, toward these ends, because such a strategy entails significant change in the cultures of the nation's security establishment.