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War gaming in the information age: Theory and purpose

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Abstract: Impressive new information technologies have not changed human beings and their abilities; neither have they changed to purposes of, or the principles behind, war gaming. It has added new problems, however, and it has made even more difficult the resolution of enduring problems that were critical twenty years ago.

Full text: Over twenty years ago, a study was carried out under the sponsorship of the Defense Advanced Research Projects Agency and in collaboration with the General Accounting Office to survey and critique the models, simulations, and war games then in use by the Department of Defense.' From some points of view, twenty years ago means ancient history; changes in communication technology and computers since then can be measured only in terms of orders of magnitudes. The new world of the networked battlefield, super-accurate weapons, and the information technology (IT) revolution, with its instant communication and seamless feedback, seems as far away from the mud of trench warfare in Flanders field as World War I was from the battle of Agincourt.

The present era in society, business, and warfare has been called "the information age" and with good reason, given the extraordinary influence that the exponential advances in information technology and the increasing accuracy and lethality of weaponry have had on these institutions. But human beings and their biological data-processing, interpreting, and decision-making abilities have not changed at the rates of these impressive technologies. Indeed, they have not changed at all. Neither has the new technology changed the purposes of, or the principles behind, war gaming. It has added new problems, however, and it has made even more difficult the resolution of enduring problems that were critical twenty years ago. Notwithstanding the indisputable benefits of many forms of gaming, formal model building, and simulations, it appears that these sciences-as was the case with operations research, the behavioral sciences, and artificial intelligence (and now "complexity theory")-were heavily oversold and their promise rashly overestimated in the 1960s and 1970s.

From their introduction by William McCarty Little in 1886, only manual war games were played at the Naval War College in Newport, Rhode Island, until 1958, when the Navy Electronic Warfare Simulator was built, heralding a new era in war gaming by tying it to the computer. Others were to develop this link to ever greater degrees. The expansion of new gaming centers at the Air War College, the Army's Training and Doctrine Command, National Defense University, and at the Joint Forces Command (until October 1999 the U.S. Atlantic Command), along with the growth of for-profit consulting companies, helped to spread computer-based gaming and led to advances in war gaming and military operations research. These developments were not an unmixed blessing, however.

Along with the greater ability to handle complexity and administrative detail came a potential for loss of "transparency"-awareness by players of a game's underlying assumptions-and a temptation to add "realistic features" to games, because it was so technologically easy to do so, without thinking much about whether the additions added to or detracted from the games' underlying purposes. The push for added complexity rarely came from the people who thought games were a good way to test concepts or plans. Rather, it originated mainly from the technical community of analysts and gamers. There is now a divide between an increasingly specialized community of gamers and modelers on the one hand, and policy makers on the other; this divide is greater today than it was in the 1970s. Garners have to market their capabilities the way any business does. There is nothing wrong with this, per se. But experience indicates that this marketing, and much of gaming's development over the past twenty years, has been aimed at other gamers rather than the policy-making community. It has been aimed even less at casting light on new challenges to U.S. security management, challenges that barely existed twenty years ago.

Why has this happened? The reasons are, first, that with computer-driven games it becomes easy to hide layer upon layer of complexity behind user interfaces that few people understand; and second, that the impact on the policy process of program "modules" that are opaque to players is not considered. There is much to commend simplicity, in light of the inherent limitation of human data processing, especially when dealing with decision makers. With manual war games, it was not feasible to add "bells, whistles, and gongs"; careful thought was required in designing every single move in the sparse abstraction that constituted a game.

Over the last twenty years, however, models, simulations, and games have merged with each other. The boundaries separating them are no longer clear, making overall assessment far more difficult. Modeling has become more complex, but thinking has not. The very unreality of manual games made them real, in the sense that it forced attention to key questions. That is why simple board games, like the Kriegspiel, were adopted by European general staffs in the nineteenth century. Playing them sharpened everyone's tactical and strategic sense. As Karl von Mueffling, the chief of the General Staff of the Prussian army, declared in 1824, at the very start of war gaming, "It's not a game at all, it's a training for war; I shall recommend it most emphatically to the whole army." Asked what games they like to play and what strategists they read, today's Chinese generals give an illuminating answer: they play Go and read Sun Tzu, because beneath their surface simplicity, the generals tell us, "there is great complexity."2

The advances in gaming since its inception have been large, whether we consider table games at the platoon level, tactical exercises, theater games, or politicalmilitary games up to the level of global war. But despite the greater complexity and technology, many old problems remain, and have even been magnified. The fascination with analytics and the attractiveness of trying to quantify phenomena we do not know how to describe accurately, let alone measure, suppresses many phenomena that may be of the essence in the darkness, turmoil, and confusion of real war. CNN pictures of "smart" missiles homing in on targets hardly convey the factors of morale, bravery, improvisation, trust, and the many others that weave a great armed force together.

As yet, computers do not provide wisdom. Seasoned, nonpartisan referees like Frank McHugh, military historians with the skills of a Harvey DeWeerd, and operational analysts of the quality of an Edward Paxon of RAND-all names that are likely unknown to the current war-gaming community-were once able to provide experiential depth that is still needed but is now harder to obtain than ever. A striking feature of the current gaming environment in contrast to that of two and three decades ago is the absence of generalists with an overview of both gaming technology and the decision-making process by which things actually get done. This is not just carping about the good old days: such generalist outlooks are now being applied to, and revolutionizing, a different field. Information technology is transforming business processes precisely because "e-business" has emphasized the in IT-the information, not the technology. Managers who understand corporate decision processes and market requirements have gotten their hands around corporate IT systems and wrestled them away from the technicians. The ongoing transformation of American business proves that this can be done and what it can achieve. A similar process in war gaming should begin.

THEORY AND WAR GAMING

The three decades after the great contributions of technology and analysis to winning World War II-contributions symbolized by the atom bomb, operations research, and cryptography-were heady, optimistic years for the application of computers to national defense. The driving idea was that a machine, the computer, would scale upward the analyses then being invented in the diverse fields of artificial intelligence, operations research, game theory, simulation, and formal organizational theory. The brave, new, modern world had dawned.

Whole new organizations were built, because the "old" ones did not get the message. Think tanks like the RAND Corporation and the Hudson Institute entered their golden ages. The first Monte Carlo (probabilistic) simulations made their appearance, and bigger and better digital models were immediately planned. The optimism was such that the Systems Development Corporation was spun off by RAND to perform simulations of unprecedented scale. The Office of Naval Research was "Lady Bountiful" to students of relevant theory. The Advanced Research Projects Agency supported consultants and researchers in management science and decision theory. The spirit of the times was that all problems would fall to analysis or simulation within the next decade.

The work of the mathematician John von Neumann on the representation of the anatomy of games by "game trees" and that of Claude Shannon on information theory provided for the first time a notation for, and understanding of, microstructure information flows, as well as a scientific method for investigating the basis of decision making. Herbert Simon predicted that the world chess championship would soon fall to a computer. The faculty at Carnegie Tech would provide business with scientific means for management. Robert McNamara was to do the same, first at the Ford Motor Company, then at the Department of Defense.

The progress made in those days, and afterward, was real and impressive, but the Cerebus paradox was soon encountered: every time a problem was solved, several more unsolved problems sprang up to replace it. The statement that various key problems in the decision sciences or in artificial intelligence would be solved "next year" turned out to involve, in effect, a DO LOOP where NEXT = NEXT + 1. A prediction in 1970 from Marvin Minsky, a pioneer in artificial intelligence, shows the point: In from three to eight years, we will have a machine with the general intelligence of an average human being. I mean a machine that will be able to read Shakespeare, grease a car, play office politics, tell a joke, have a fight. At that point, the machine will begin to educate itself with fantastic speed. In a few months, it will be at genius level, and a few months after that, its power will be incalculable.3

Our perspective, nevertheless, is not pessimistic. On the contrary, the tools that prompted such predictions had given means to attack a vast array of basic and previously unapproachable problems. The early successes and the quantum leaps taken created a Camelot-like feeling of invincibility. A fundamental understanding of human behavior was presumed to be just around the corner. However, the early attempts to simulate checkers and chess, or to attach artificial arms and eyes to computers and tell them to pick up building blocks and put them on top of other ones, showed that far deeper and more subtle problems were involved than had been thought. The same thing happened in war gaming and game theory. Far from solving all problems of human interactions, the knowledge yielded by game theory helped to demonstrate that simplistic concepts of optimal strategies and rational behavior were highly limited in application. In the new game models there was no morale; leadership had no meaning; passion and anger could not be portrayed. The simplification of the individual to a mechanistic decision maker stripped these away, and with it virtually all of the qualities that a good war college tries to instill.

Nuclear war games, for example, were built around grand optimization across the major commands responsible for these weapons, becoming giant linear-- programming routines for building "optimal" nuclear strike plans. The very names of the models-such as the "Arsenal Exchange Model"-suggested mutual silo-emptyings, the launching of thousands of missiles to destroy the other side's forces. Models were built of sufficient scale to manage such exchanges, but too much was left out that was important. The behavior of the isolated commanders with thousands of megatons under their control;4 the reaction of Nato allies to having World War III fought through the suburban sprawl of Europe; and whether the Polish army should be counted in the "Red" or "Blue" order of battle-all these issues were conveniently left out of models and games. These "gaps," however, happened to be the points of greatest concern to decision makers.

Formal game-theoretic analysis has an important cautionary lesson to teach here. A simple analysis of any multistage game of even moderate complexity (chess will do) shows us that even in so simple a case, human data-processing capacities and perceptions rule out unrestricted proliferation of information. The human being is a sophisticated but limited-capacity processor of information and can deal with voluminous input only if it is aggregated, or "chunked." The human is a social animal, for whom "know who" counts as much as, if not more than, "know how."

Another limitation concerns communication, the complexity of which is illustrated by an age-old military problem, the command and control of a multinational army-that is, an army composed of many national or ethnic parts. (This problem is becoming important once again, with coalition wars on the rise.) In 1918, officers of the Austro-Hungarian Empire barked orders first in German and then in four other languages in quick succession if they wished to convey to their troops what they had in mind With differences in language come differences in cultural perceptions and in shared knowledge and customs, and considerable potential for misinterpretation. New technologies speed the transmission of symbols and facilitate computation, but they hardly influence the interpretation of meaning, the discernment of patterns, or the drawing of inferences from complex, noisy contextual data.

In terms of the future of war gaming, developments in theory bring the message that the major improvements are needed less in technology, in "newer toys for bigger boys," than in persuasively written scenarios, assessments of why players did what they did, and postgame debriefings of what was actually learned. The gold lies in human thought-assisted by modern communication and computers, not distracted by them. An emerging appreciation of the complexity of human behavior has humbled the decision sciences, and it has simultaneously made them more useful, as their practitioners gain better and more realistic feelings for the scope and limits of their crafts.

ENDURING ISSUES

That there are new challenges in war gaming does not mean that all of the old challenges have been met. On the contrary, the long-standing problems of thinking through a game's purpose and drawing lessons from it are handled no better today than thirty years ago. In some cases, this failing is made worse by the inappropriate application of new gaming technology and by failure to understand its proper uses.

One aspect of failure to think through fundamental purposes is an inability to make the basic distinction between the explicit game being played and the implicit one. The explicit game is the official event, the one presented in the briefing book and described in the orientation lecture that precedes game play. Should a new weapon system be upgraded? Will North Korea fire its weapons of mass destruction? Illuminating such questions is an explicit purpose of war games. But very often, equally or even more important implicit games are being played at the same time. This is the game that cannot be mentioned in the official briefing, the one that asks questions that are too sensitive to pose explicitly but that savvy players recognize are the really important ones-fundamental issues of strategy and cost.

In the late 1930s, Joseph Stalin had his generals game the defense of the Soviet Union against German attack. Stalin ordered the conditions of defense precisely: massed troops on the border in a linear defense. The more perceptive Soviet generals knew that such a defense would mean disaster in the event of German attack, an intuition that turned out to be correct. They also knew what defying Stalin by playing another strategy in the official game would mean. They played the linear defense in the official game, because they had no choice; however, they also held after-hours conversations about the consequences of following the official plan, and they staged informal, verbal games based on the official one but relaxing the political constraints. This is a common phenomenon known as "shadow gaming."'6 The most interesting questions are frequently not officially reflected in the game but are nonetheless implicitly understood and become part of the tacit knowledge that players take away. Yet there is almost no analytical attention given to the shadow game, even to its identification of issues.

Tacit knowledge often concerns what players thought they were doing and what players would have done if the game had taken another path, It is almost never mined for its full value. This is a problem that has been made worse by the nature of many decision-support systems (DSSs) used in games. In practice, most DSSs focus on explicit prospective choices without going back and retracing alternative courses of action. They overlook

retrospective choices and the sensitivity of later decisions to earlier ones.
Most DSSs also stick with official rules past the point where this makes sense. Consider the target-identification problem. When a war goes badly, confusion increases, and objectives slip out of reach, the rules governing the identification of permissible targets begin to change. Fire discipline erodes. In a highly constrained war like the air campaign against Serbia, there are three things on the battlefield: friends, foes, and neutrals. But as the Vietnam War showed, once matters start to deteriorate, the boundaries between these distinct categories begin to blur, especially between neutrals and friends or foes. This is a very important issue, because that particular distinction not only forms the basis of much current strategy-victory with minimal collateral damage-but has led militaries to acquire very expensive surveillance and targeting systems, and highly accurate weapons. The ways in which these systems could fail in circumstances in which victory seems attainable only with considerable collateral damage depend on different paths taken in a game. But these contingencies are almost never analyzed, and they are not captured by extant DSSs, whose rules stay fixed throughout a game.
In the corporate world of e-business, however, the distinction between explicit and tacit knowledge is central to knowledge management! Capturing and codifying tacit knowledge is a high priority in corporate America, because it is a major source of competitive advantage.8 Yet although they now use similar technologies (Groupware, Expert Systems, Neural Nets), war games achieve little payoff compared to what is taking place in business.
NEW CHALLENGES
If over the last twenty to thirty years both principles and purposes in gaming have remained the same, technology has of course changed, and so have many problems (in part because of the change in technology), problems that require new kinds of analysis in which gaming could be of great use. The greatest of these new challenges are: the revolution in military affairs; weapons of mass destruction; multipolarity, and the rise of Asian military power; the issue of the nation-state as the central actor in international affairs; information warfare; and international financial linkages and financial warfare.
Whether or not one accepts the argument that the United States is now at the beginning of a revolution in military affairs (RMA), it seems clear that technological enhancements in the form of precision strike weapons, information warfare, and systems of unparalleled interconnectedness mark a change in the nature of warfare, a change that is fundamental. It is important to assess the consequences of this change at several levels: strategic, operational, organizational, and technical.
The current art of war gaming is not up to the job. Partly this is because the problems are inherently difficult; but it is also because of an absence of professionals trained or willing to cross over into different intellectual fields. Broadly speaking, strategists and policy experts do little or no analysis whatever; they simply posit sweeping portraits of the future, basing them on the changing nature of war or the structure of the international system. On the other hand, technical people with specialized training in software and war gaming are seduced into emphasizing the use of these tools rather than focusing their attention on the real problems of a revolution in military affairs.
In practice, games that try to analyze an American RMA tend to leave out too much, such as the highly plausible response on the part of other countries of simply accelerating their adoption of weapons of mass destruction. A case can be made that this is now taking place, without anyone acknowledging it. The high-profile use of high-tech U.S. forces against Iraq, Serbia, and others is producing in many countries a sense that they cannot possibly compete on these terms; rather than giving up and accepting American power, they search for a "poor man's RMA" in biological and nuclear weapons. This is not to argue for a low-tech American approach. But it is striking that the "poor man's" counter to high technology has not been seriously gamed, as to either its system-transforming effects or its operational ones. Fortunately, and notwithstanding the near misses of the Aum Shinri Kyo in Japan in 1995 and the Iraqi weapons programs in 1991, no use of biological or nuclear weapons has taken place. But the potentials are enormous and horrendous, and our experiential base is

negligible.

The rise of Asian military power, as reflected in the adaptation of ballistic missiles and weapons of mass destruction in a connected belt of countries extending from Israel to North Korea, is a related development that cries out for broader gaming and analysis. For five hundred years the West has militarily dominated Asia by gaining control of bases on the continent's maritime rim and by exploiting a technological advantage. It was a classic competition between the strategies of Halford Mackinder and Alfred Mahan-the former an advocate of continental land power, the latter the father of American maritime supremacy.9 Military geography itself is almost extinct as a subject area in the United States, replaced by a myth of the "death of distance" and an assumption that a United States able to keep its technological lead will also be able to sustain indefinitely a five-hundred-year status quo in Asia.'

There is little evidence of gaming of the competition between continental and maritime strategies. Missiles armed with mass-destruction warheads undermine the Western Mahanian strategy. Bases on which U.S. military power relies, and perhaps even the capital ships that enforce presence, are exposed to unprecedented dangers. Should the United States protect these forward bases with theater-ballistic-missile defenses? Will the cost of staying forward in Asia go up sharply as a result? These are questions that either have not been examined at all or have been looked at only in the narrow tactical context of the kill probabilities of interceptor missiles.

One of the great contributions of game theory has been to the study of the two-person game. In the Cold War, the development of the two-person, zero-sum game fit in naturally with worst-case scenarios and evaluations of "Red" capabilities; in addition, the literature on two-person, non-zero-sum games brought to light many paradoxes in the estimation of threats and the role of communication. All of this work and the gaming carried out in parallel with it applied nicely to a bipolar world of the United States versus the Soviet Union. Although there were many allies involved, the "Blue bloc versus the Red bloc" supplied a good first-order approximation. Since the dissolution of the Soviet empire and the growth of the Asia-Pacific powers, this easy simplification into two-person games has become impossible. The multipolar world is far more difficult to study, from every point of view. Such problems as nuclear stability become far more complex when formally extended from two players to a multipolar world. The complications in analytics are computational and combinatoric. The complications in global strategy are more conceptual and judgmental, involving the guessing of, say, likely North Korean reactions or the future behavior of the Israelis or Palestinians.

As for the nation-state, we are all its creatures, and Americans in particular take it as an axiom that their nation is the "great melting pot. There are Americans of many races, colors, and creeds. But the nation's very self-image depends on trying to perfect the imperfect, the unfortunate reality of prejudice against various minorities. We cannot, therefore, dismiss the influence of communications on the "global village." With the growth of the Internet and international enterprise, the concept of the "inhabitant of the global village," of the citizen of the world, takes on new meaning. This is a matter not only of rhetoric and ideology but of basic social structure. Today, a computer-literate immigrant to the United States never really leaves home. The very term "immigrant" confuses place with space. A computer programmer in Palo Alto (a place) who recently migrated from India maybe in continuous touch with his family in Bangalore or with his former employers in the defense ministry in New Delhi (a space). The Dutch president of a U.S.-German conglomerate newly merged with a French-Italian-Japanese holding company may stress his loyalties to his international stockholders, but when one can no longer tell where the lines are, it is difficult to decide what side one is on. In a multi-allegiance world, an Iraqi dictator finds little difficulty in buying oil pipelines that look surprisingly like three-hundred-foot gun barrels, designed by an engineer holding a Canadian passport but whose national identity is more akin to that of Werner von Braun than that of a citizen of a single country.

World financial markets have been interlinking at breakneck speed. In many aspects of finance there is in essence a world market. A transaction in Japan can be felt in New York as though it occurred locally. There has been some concern that this interlinkage opens the door for a new form of economic warfare involving the destabilizing of markets and the deliberate creation of panics. The evidence is not clear. Recent studies raise questions concerning the difficulties of destabilizing markets, notwithstanding popular fiction by Tom Clancy (Debt of Honor) and other writers." Games that have brought in actual "inside players"-representatives of leading Wall Street banks and brokerages-seem to show that it is difficult to spread such disruption in the massively redundant marketplace.12 Financial warfare games also show, in an unintended way, how financial priorities overtake foreign policy goals-a subject in need of much more careful analysis.

The new implications of information warfare involve misinformation and deception more than they evoke images of seamlessly functioning operations rooms with hundreds of well dressed and unflappable control personnel facing consoles and multimedia wall-display screens reminiscent of Dr. Strangelove. In a day when television can make nonexistent billboards (with advertisements for sponsors) seem to appear in Times Square during television coverage on New Year's Eve, the old adage that "the camera does not lie" no longer offers the comfort it did in the days when film-doctoring was an expensive and difficult art. Paradoxically, the growth of information technology is more and more in the favor of disinformation technology, thanks to naive users who concentrate more on the technological wonder of the information displayed than on the context of who generated it and what it means. 13

The theatrical aspects of military action have been grist for postmodern scholars-a literature that is unknown to the gaming community." Yet the close connection between visual stimulation (and manipulation) and games is well understood by Las Vegas casino operators, successful politicians, and designers of commercial video games (such as "Rainbow 6" and "Civilization"). Man is a visual animal. The imminent availability of broadband technology and Internet2 means that on-demand video will be as thoroughly taken for granted in the future as telephones were in the 1950s.15 This undoubtedly has many important implications for war gaming.

DANGERS PERCEIVED AND SOME RECOMMENDATIONS

The explosive growth of communication in the information age, whether in military or corporate organizations, has created a pressing need to game the bureaucratic process in its assorted pathological behaviors, jurisdictional turf battles, time delays, miscommunications, autogenerated mistakes, and propensities for random estimates, disinformation, and information vandalism.

U.S. government "estimates" of likely Boeing AH-64 Apache attack helicopter attrition in the 1999 war in Kosovo illustrate this need better than any fictional scenario ever could. In that campaign a major innovation was real-time teleconferencing, by which field commanders collectively estimated that there would be five losses per hundred sorties for the Apache were it committed to combat against Serb military forces in Kosovo. At the Pentagon, this estimate was somehow turned into a 6-to- 15 percent attrition rate; whether this growth occurred through miscommunication or reassessment using different analytical tools is not known. This higher number was used to brief the National Command Authorities (that is, the president and secretary of defense) on whether to employ the Apaches. At the White House the figure was again either miscommunicated or somehow recalibrated; one senior official thought he was told to anticipate a 50 percent attrition rate. Given the political sensitivity to casualties in this operation, it was not hard to guess where this would lead. The Army had already moved twenty-four Apaches to Albania-along with fourteen M- 1 tanks, two Bradley fighting vehicles, twenty trucks, and thirty-seven transport helicopters to support them-using 550 sorties of the C-17 cargo aircraft, as well as sea lift. In all, the Army had sent 6,200 troops and twenty-six thousand tons of equipment to support the Apache deployment. But when senior political leaders saw the attrition estimates (5 percent? 15 percent? 50 percent?), this immense effort went for naught. The combat mission for the Apaches was killed outright; they never flew in battle.

Strategic-bureaucracy games with a minimum of three or four teams playing the roles of different departments, with communication between them imperfect, the noise level high, and autogeneration of mistakes likely, might make a convincing case that these problems must be rectified. There are solutions. The QVC Home Shopping

Network, Goldman Sachs, and other firms operate processing systems that integrate and stabilize their bureaucratic behavior, at least for mission-critical tasks. What they have done is carefully examine information, not just technology, and connect business knowledge with technical expertise.
Defense organizations, of course, face a hazard that most corporations do not-threats to security. The concern is less with the adequacy of 128-bit encryption systems than with "moles," secretly working for opposing players. In the information age, moles can have devastating effects, because these agents work to reveal the keys to technical systems that take many years to field and that are increasingly at the heart of American competitive advantage over other countries. Consider the consequences of a Klaus Fuchs, Aldrich Ames, Jonathan Pollard, or a Ronald Pelton. Pelton, a National Security Agency technician, gave away the capabilities and coverage gaps of a multibillion-dollar U.S. surveillance program. Inclusion of moles should be a consideration in future war game design.
There is also a need for a class of games that go beyond the traditional politicomilitary crisis exercise. There should be a renewed emphasis on "path games"-in which strategic decisions are made sequentially over an extended time frame, in an attempt to illuminate long-range consequences-in a collaborative effort among the war colleges, the Defense Department, and the academic community. These games should stress ten-to-twenty-year branching scenarios. At a time when the United States is the sole superpower, there is a dangerous tendency to focus only on short-term crises, overlooking the complicated and varied ways that the nation's preeminence could be challenged. It is one thing to look at missile defenses to protect South Korea, Japan, or Taiwan against attack; the twenty-year implications of deploying theater-missile-defense systems to Asia and the Middle East are a very different matter. Such issues have not been examined even in terms of obvious measures, like the economic damage-- exchange ratio of a protracted missile-antimissile competition. It would be extremely interesting in particular to run, on theater missile deployments in Asia, a twenty-year path game that included a Pelton-like mole on the "Blue" team, someone who could reveal the technical performance characteristics and vulnerabilities of the deployed antimissile system to an opposing player. War gaming has had a distinguished past and should have an important and distinguished future. This future depends on conceiving computer games and strategy as complements to one another. There is an unfortunate tendency to conceive of them instead as substitutes. Successful IT companies do not make this fundamental mistake. Nearly all of them have obliged information technology to support the businesses, rather than the other way around.
Improvements in computing and simulation make "soft gaming," such as the politico-military exercise, more important than ever. Because supporting information-the distance between Saigon and Seattle, or the population within a ten-mile radius of the center of Seoul-can now be obtained almost instantly, more time should be spent examining the nuances of scenarios, and more resources should be aimed at exploiting the assistance that military history, political science, and social psychology can offer.
There will always be enough money for highly computerized tactical games and simulations in the budgets of the proponents of various weapons systems. Unfortunately, the more strategic the problem, the harder it is to obtain funding to examine it. Is that because the outcomes of such studies do not look like the crisp, quantified "deliverables" of technical consultants?

Sidebar

The gold lies in human thought-assisted by modern communication and computers, not distracted by them.

Sidebar

Notwithstanding their indisputable benefits, it appears that these sciences were heavily oversold and their promise rashly overestimated in the 1960s and 1970s.

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In the new game models there was no morale; leadership had no meaning; passion and anger could not be portrayed.

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There is now a divide between gamers and modelers, on the one hand, and policy makers on the other; this divide is greater today than it was in the 1970s.

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Footnote

NOTES

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1. G. D. Brewer and Martin Shubik, The War Game (Cambridge, Mass.: Harvard Univ. Press, 1979).

2. Based on an informal survey by the authors, carried out in personal conversations during 1998-2000.

Footnote

3. Quoted in Thomas H. Davenport and Lawrence Prusak, Working Knowledge: How Organizations Manage What They Know (Cambridge, Mass.: Harvard Business School Press, 1998).

4. See Paul Bracken, The Command and Control of Nuclear Forces (New Haven, Conn.: Yale Univ. Press, 1983).

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5. Istvan Deak, Beyond Nationalism: A Social and Political History of the Habsburg Officer Corps, 1848-1918 (New York: Oxford Univ. Press, 1990), pp. 99-102.

6. See Paul Bracken, "Unintended Consequences of Strategic Gaming," Simulation &Games, September 1977, pp. 283-318.

7. Davenport and Prusak, Working Knowledge. 8. Rob Mattison, Web Warehousing and Knowledge Management (New York: McGraw-Hill, 1999).

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9. Paul Kennedy, "Mahan versus Mackinder: Two Interpretations of British Sea Power," in Strategy and Diplomacy, 1870-1945: Eight Studies (London: George Allen and Unwin, 1983), pp. 41-85.

10. For the checkered past and present potential of geopolitics, see Mackubin Thomas Owens, "In Defense of Classical Geopolitics," Naval War College Review, Autumn 1999, pp. 59-76.

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11. Martin Shubik and R. L. Slighton, The Defense Implications of the Recent Changes in World Monetary and Financial Systems (New Haven, Conn.: 25 October 1997); and

M. F. Stollenwerk, "Financial Operations: Opportunities for Inter-Agency Synergy," U.S. Command and General Staff College, Fort Leavenworth, Kansas, 1999.

12. Economic Security Exercise, simulation played in New York City in September 1997 under the sponsorship of the U.S. Naval War College and Cantor Fitzgerald, a New York investment bank.

13. John Arquilla, The Advent of Netwar (Santa Monica, Calif.: RAND Corporation, 1996); and R. C. Molander, A. S. Riddile, and P. A. Wilson, Strategic Information Warfare (Santa Monica, Calif.: RAND Corporation, 1996), pp. 22-4.

14. Jean Baudrillard, The Gulf War Did Not Happen (Bloomington: Indiana Univ. Press, 1995).

Footnote

15. Internet2' is a proposed follow-on to the present Internet being developed by a consortium of universities, industries, and government. Its primary aims are to "create a leading edge network capability for the national research community," to "enable revolutionary Internet applications," and to "ensure the rapid transfer of new network services and applications to the broader Internet community." About Internet2, retrieved 25 October 2000 from the World Wide Web: http://www.Intemet2.edu/ html/ about.html.

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