# U.S. Wargaming Grows Up:

## A Short History of the Diffusion of Wargaming in the Armed Forces and Industry in the Postwar Period up to 1964

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One of the surprising findings of this research was how rapidly the practice was accepted by the various services. In less than a decade, war-gaming moved from being a little known adjunct to operations research to attain the status of a controversial, but popular exercise established in every service command and division.

Navy Gaming[1]

The immediate precursor for Navy cold war simulation gaming were the few games played by operations researchers in the Antisubmarine Warfare Operations Research Group (ASWORG) and at the Naval Ordnance Laboratory during WWII. In the first instance, a machine game was devised to simulate submarine aerial surveillance and tactical evasion.[2] In the second case, a mining warfare game was created by Ellis Johnson, chief of the Naval Ordnance Laboratory's countermeasures section.[3] Gaming was nonetheless not regarded as an important technique of wartime naval operations research.[4] It was, however, a long-standing tradition at the Naval War College, which had conducted map games since the late 19th century.[5] More importantly, unlike the other services, it continued to play manual wargames in the immediate post-war period. While these practices were called "map exercises," in 1953 the term "war game" was reinstated at the Naval War College with the inauguration of a program to develop a strategic game. In May 1955, the Naval War College instituted an annual week-long strategic game, an event which preceded the establishment of the service-wide Navy War Games program and the War Gaming Department at the School by several years.[6] The "School of Naval Warfare Strategic Game" was a manual wargame which pitted the super-powers, Blue and Purple, against one another in global political and military conflict. Naval War College game director Francis McHugh explained, "It [was] a two-sided educational game with the emphasis on decision-making at the national level."[7]

The development of the machine-simulation, the Navy Electronic Warfare Simulator (NEWS), was conceived at the end of the war as a substitute for the manual games at the Naval War College. Early in 1945, the construction of a combat information center "trainer" at the University of California was brought to the attention of officers in the Bureau of Ships, who passed on the idea to the Naval War College. By November 1945, the Chief of Naval Operations authorized the Bureau of Ships to begin the development process on a navy warfare simulator.

Originally it was envisioned that the simulator would employ electromechanical means for moving forces, establishing contacts and disseminating intelligence, and would include appropriate communication facilities. Thus, it would eliminate such cumbersome board techniques as filling out move forms, plotting moves, juggling screens and curtains, etc., and permit time to be handled as a continuous rather than a discrete variable.[8]

The NEWS was ready for the academic year 1957-58. The game was a two-sided, one-map game with three major parts: maneuver and display, damage computer, which was installed in 1958, and communications.[9]  While the Command and Staff Department of the college began to play game on the NEWS, the annual strategic war game continued to be manually played until 1960.[10]  As a sign of its growing significance, in June 1959, a formal War Gaming Department was established at the Naval War College. The following year a week long wargaming course became required for all fleet officers, which focused on the capabilities as well as the limitations of fleet gaming on the NEWS.[11]

Even though the NEWS had been intended for training, McHugh noted that "it became apparent -- even during the design and installation phases -- that the NEWS was a valuable tool for exploring actual naval operations."[12]  It was understood that war-gaming could provide training and operational information much more economically than outlays for actual task force exercises.[13]  Consequently, when the Chief of Naval Operations established the Navy War Games Program in May 1958, the NEWS was regarded as the chief resource for examining fleet and force exercises and plans in advance of actual operations.[14]  A separate computer analysis division was also part of the program, which focused on a naval air defense war game played on digital computers.[15]

In 1960, the Marine Corps introduced wargames at its Marine Corps School in Quantico, VA.  The Landing Force War Game was a two-sided, rigid, manual research game. Its purpose was to analyze and develop tactics and new weapons systems.[16]  The Marine Corps Educational Center also utilized an Amphibious Assault Trainer, in which "the student can see the entire amphibious operation in miniature."[17]

Air Force Gaming[18]


If we turn to Air Force gaming, again we see the pattern of gaming on the margin of operations research during WWII, and coming into central focus in the late 1950s.[19] More important to the history of Air Force gaming was its long-standing familiarity with flight simulators. In 1951, the Air Force contracted with the University of Chicago to create the Advisory Board for Simulation, (which was later renamed the Institute for System Research,) in order to explore design requirements of flight control systems.[20] Throughout the decade and into the next, simulation laboratories were set up by the Air Force and its contractors to aid in systems engineering problems, and train pilots and astronauts.[21]


Mathematicians at the RAND Corporation devised the Air Battle Model I, (ABM) which was a simulation of global nuclear war.[22] It was tested in the summer of 1955 at the Air War College at Maxwell Air Force Base in Alabama. According to Peter Perla, the game was "notorious for [its] inability ... to deal with the attack and defense of navy carrier battle groups."[23] The ABM was transferred to the AF Director of Plans in December 1957, which contracted with the civilian contractor, Technical Operations Research, Inc. to finish the design work.[24] In 1957, Tech/Ops established the project office OMEGA in order to translate the experimental design of the first model into a functional simulation for staff officers.[25] That same year, the Air Force established the Air Battle Analysis Center, a headquarters-level gaming office. (And, like the Navy, the Air Force introduced wargaming into its curriculum at the Air Force Academy.[26])


Given its reliance on a weapons systems complex, the Air Force was at the forefront of computer gaming. An article in the Air University Quarterly Review of Winter 1956-57 commented, "Indeed the speed with which these weapons could react, each to the other, seemed to indicate that only a machine with vast memory and instant response could be expected to indicate a successful counter strategy in sufficient time to be useful."[27] Within a year of this article's publication, the Air Force unveiled the SAGE system, which did indeed seem to promise the automation of a nationally coordinated, computer-dependent defense. SAGE nicely demonstrates the intertwining history of computer development, machine and computer gaming, evolving business management practices with its theory of organizational control, and industrial automation in this period. Perhaps the most significant Air Force project for its effect on American defense and the economy in the 1960s, SAGE (Semi-Automatic Ground Environment) was inaugurated in June 1957.[28] It was a network of digital command and control computers located throughout the nation. The SAGE system monitored radar intelligence in Canada and the United States, tracking friendly air traffic and, potentially, unidentified incursions into North

American airspace.  Synthesizing radar information, it could automatically determine flight speed and location, and tag potentially hostile incoming bombers for defensive assault. It was a gigantic application of the first generation of high-speed computers with magnetic core memories.  The development of SAGE employed most of the country's existing cohort of programmers, and further particularized the division of labor among them.[29]  (Analysts at the non-profit System Development Corporation (a RAND spin-off) devoted approximately 1,800 man-years devising SAGE's programs.[30] )

The application of SAGE systems technology to commercial concerns was not lost on business journalists. A Fortune  reporter, Gilbert Burck noted that, "SAGE simulates a large business system with strategically located division offices, all bound together by an information-and-control network."[31] Recall that from the years 1957 through 1964, computer manufacturers faced the challenge of persuading corporate managers that data processing technology could function as more than bookkeeping devices. IBM salesmen and systems engineers dedicated themselves to demonstrating the staggering computational, simulatable, synthesizing and coordinating potentials of their machine. Burck's article, "'On Line' in 'Real Time'" is a representative example of the brief historic moment in which it was necessary to frame (in the most appealing way possible) the new technologies of continuous information transmission, data storage and recovery in light of the equally avant garde systems approach to corporate management.  Burck made use of one of the prevailing leitmotifs of the historical moment, namely the antagonism between primitive experience with its "guesses and hunches" and the indomitable power -- not to say omnipotence -- afforded to the rational, systems-oriented, computer-reliant manager.

 ... after the business has become "computerized," and the records of its "transactions" over the years have been stored in the machine's memory... ... [the manager] knows precisely what has happened and why, what should be happening and why, and he has an excellent notion of what is likely to happen, and what is the best way of forfending or capitalizing on it all. He can rely less and less on guesses and hunch and more and more on analysis.... the machine can help him expand and elevate his native intuitive powers to new levels.[32]

Given the public mood regarding automation, the notion of enhanced human cognitive power wrought by the computer easily shifted to the fear of automated decision-making. Burck reassured his audience that the SAGE system was a paragon of man-machine complementarity. "One big lesson it teaches, aside from the fact that it puts the whole business on line in real time, is how to manage the symbiosis of man and machine.  SAGE matches the two easily and naturally, letting the computer help rather than take over..."[33]

In addition to the SAGE system, the Air Force made use of computer games for research into optimum targeting strategy. In the summer of 1960, a series of computer wargames were played at the AF chief of staff level to investigate the outcomes of a Soviet first strike, and an American first strike, with differing target lists.  The result confirmed arguments that had begun to be aired by defense analysts at RAND and other sites since the late 1950s -- namely, a strategy which avoided cities and concentrated solely on the defense installations of the enemy was the least catastrophic, most successful means of waging nuclear war and surviving.[34]

Like the Navy, the Air Force employed the spectrum of the modes of gaming as a means of training simulators from field exercises to computer games.  In the early and middle years of the 1950s, the Strategic Air Command (SAC) and the Continental Air Defense Command (CONAD) staged joint annual wargames. One enthusiast remarked that these exercises achieved the "ultimate in short-range war-gaming."

Probably no game involving actual force deployment is purer, more easily evaluated in terms of system efficiency and training, nor offers greater realism to the participants.  Staffs at all levels are exercised against an opponent whose capability and intentions are not, perfectly at least, known.  The presentations are authentic; the decisions are authentic up to the point of simulated weapon release (CONAD) or beyond (SAC).[35]

RAND Gaming

The Air Force contractor, the RAND Corporation, played a significant role in the development of war gaming, first by pioneering techniques, as well as helping to diffuse them to the Air Force and the Joint Chiefs of Staff, the State Department, to universities and to corporations.  RAND explored every mode of war-gaming described above, and in many ways set the standard for the practices of other research groups and those to follow later. Among the first wargames played at RAND in the early 1950s was a an exercise called "COW", which had been designed by mathematicians.  It was a multilateral cold war game involving 20 players (representing 20 states). The game was played with reference to a mathematical model of international relations.  An entry listing RAND's wargaming activities for the Army's STAG Directory  affirmed, "Despite grossly unrealistic features, it demonstrated the possibility, in principle, of applying scientific modeling methodology to a field as vague as the political arena."[36]

Dissatisfied with COW's quantitative idiom, several behavioral scientists began experimenting with role-playing crisis games. Four political exercises were conducted at RAND between February 1955 and April 1956, involving a large number of staff analysts. The experience was so compelling that RAND analysts gave briefings about political exercises to the Air Force and JCS, to scholars, and to the State Department. This stimulated wide interest in the technique, and subsequent role-playing games were tried out in many institutions.

In 1954, RAND constructed a war gaming facility, Project SIERRA, to explore Air Force strategy in limited war. The Project SIERRA wargames were two-sided, manual games that incorporated economic and political variables into the consideration of strategy, tactics, and logistics.[37] Over the decade, more than fifty limited war games were played in the facility.

RAND also conducted a great many rigid strategic games. SAW was the first such game. Played in 1948 and 1949, SAW was an elaborately ambitious exercise. "The outcome was determined by gross budgetary and weapons allocations. ... [Moreover] it considered ground and naval action in addition to air operations."[38] The follow-on to SAW, STRAW (circa 1953), was a less comprehensive game. An atomic air warfare game, STRAW explored the economic effects of bombardment to cities and industry. STRAW was played at the Air War College. Its successor, SWAP (circa 1959), was subsequently introduced into the curriculum of the Air Force Academy.

In the early 1950s, RAND analysts played map exercises as part of the Air Force Penetration Studies, which concerned themselves with a standard operations research problem, how to increase the attrition of the enemy oncoming bombers with optimal air defense. This work to the development of the Penetration Study Model, a computer game which was "essentially an aggregated air defense model coded for computing machines, capable of evaluating large scale strategic attacks on an enemy."[39] Thousands of trials of the model were run on RAND's digital computer. Following upon that, RAND analysts developed the Air Defense Model, which estimated attrition in strategic air attacks. This evolved into the Air Battle Model, a computer game that was ultimately adopted by the new Air Battle Analysis Division of the Air Force in 1957.

RAND analysts also originated a number of computer simulations that approximated automated strategic planning. FLIOP, Flight Operations Planning model, was a simulation designed for SAC, which determined the optimal flight plan for any individual mission. On the basis of FLIOP and its successor models, in 1961, RAND began the development of STRAT (Strategic Air Planner) for SAC, which would generate "a rough-cut strike plan for the total strategic forces, using the IBM 7090 computer."[40]

Other computer simulations developed by RAND included MUSTARD and QUICK COUNT, which calculated civilian and fallout casualties, respectively. (MUSTARD and QUICK COUNT were employed in the computer studies of the comparative advantages of city versus counterforce targeting, referred to above.)

Finally, RAND was at the forefront of man-machine simulation. Two simulation laboratories were built in successive order in the 1950s which explored the training and R&D potentials of fully realistic analogue environments. The Systems Research Laboratory was inaugurated in 1952 by a teams of behavioral scientists to investigate the optimal training methods for improving group performance.  The environment of the lab duplicated an anti-aircraft defense center. It was a one-sided game in which the players, the participants who role-played CONAD officers, tracked simulated radar signals of incoming overhead flights into North American airspace, identified hostile aircraft, and routed orders to defensive forces. The series of tests at the laboratory were so successful, that the Air Force spun off the group into a separate non-profit corporations, the System Development Corporation, whose purpose was to translate the findings of the man-machine experiments into ongoing training programs.[41]  The Logistic Simulation Laboratory was directed to hypothetical logistics environments for the proposed ICBM missile forces of the near-future. Rather than training, the laboratory experiments were directed towards determining the most effective management structure for future logistics operations.

Army Gaming[42]

The Army was the direct beneficiary of the Naval Ordnance Laboratory's operations research and gaming program during the war. After the war, the director of the Navy Laboratory, Ellis Johnson, was appointed to found an operations research group to serve the Army.  Unlike the Air Force's main operations research group, RAND, which was a civilian contractor, the Army established its Operations Research Office (ORO) as an adjunct to the Johns Hopkins University.  In 1950, a physics professor at George Washington University who was consulting with ORO, George Gamow, created a manual game called Tin Soldier, (played from 1951 to 1954.) Gamow is credited with devising the first mathematical war game used for analytical as opposed to tactical operations research.[43]

Alfred Hausrath, the one-time director of military gaming for the Research Analysis Corporation (RAC), the successor civilian contractor for the Army, recounted the details of a little known simulation developed at the ORO in 1948.  (The simulation also served as a model for a Naval anti-aircraft guided

missile system.[44]) Staff members of the Applied Physics Laboratory at the Johns Hopkins University worked in conjunction with the ORO in its design. What resulted was a computer game. Hausrath asserted that its successor model, a study of the air defense of North America, which was inaugurated in 1953, was the first computer simulation in the history of operations research.[45] ORO also originated the first digital computer game, CARMONETTE I, (played from 1956-60.)[46]

Given its importance to the host of computer games of the 1960s and thereafter, it is worth taking a brief look at CARMONETTE. CARMONETTE stood for Computerized Monte Carlo Simulation. There were a series of CARMONETTE games, the first was a single tank/anti-tank battle; CARMONETTE II included infantry (1960-65); CARMONETTE III added armed helicopter support (1966-1970); CARMONETTE IV added communications and night vision.[47] CARMONETTE simulated the activities of individual soldiers in a company- or battalion- sized battle. The basic combat options were deciding whether to move or stay still, to prepare to fire, to fire or not to fire.[48] It compounded the individual trajectories of each soldier into an integrated picture of the battle. The operations researcher Richard Zimmerman commented, "The major problem is to design a model of battle which can simulate typical or critical combat actions to test the effectiveness of the proposed tank company."[49] Writing the program for CARMONETTE was exceptionally difficult, game designers were compelled to tailor the possible combinations of moves to a small set of alternatives representing the most likely or most compelling options. The results were extremely rough. Zimmerman cautioned that computer games would necessarily require the supplementation and error checking provided by field experiments, "which themselves [were] at best, 'reasonable' approximations of combat conditions."[50] He concluded that tactical war gaming and field experiments should be regarded as "complementary components" of military research.

In August 1952, a conference was convened at Fort Monroe, Virginia to future explore ORO's potential for assisting the Army's R&D program. The techniques of war-gaming were advanced as an effective method for research and planning purposes. "The concept of analytical war gaming crystallized; possible the idea was born at this conference." Furthermore, it was decided that games designed for different levels of the command hierarchy should be conducted in order to enrich the service understanding of the range of warfare.[51]

Another Army-university contract was let to The George Washington University's Human Resources Research Office (HumRRO). HumRRO's task was to develop wargames for training staff officers. "It was decided to concentrate on procedures which could be used to teach the decisions which must be made after combat, or movement toward combat, has been initiated. Gaming material used at the Command and General Staff College was provided and the staff began to work up examples of new ways to present this material in a game setting."[52]

The Continental Army Command (CONARC), Combat Development Section, created its own operations research corps, the Combat Operations Research Group (CORG) as a field office of the ORO, from 1952 until October 1955.[53]  Wargaming was introduced into combat development in 1954 with the development of a separate division for War Gaming. Its first exercise was a "pretest" of a massive field maneuver in the continental US (Sage Brush.)  The War Games group gamed the war-plan of the opposing side in order to try out unexpected moves.  This first combination of combining war-gaming and field exercises was highly successful.  The Deputy Commanding General of the War Games Division, Lt. General Gordon Rogers wrote, "Upon conclusion of the exercise, the maneuver director ... stated that future field exercises should not be undertaken until they had been thoroughly war gamed in advance..."[54]

 The success of pretesting Sage Brush set the pattern for CORG's subsequent practices of combining gaming with controlled field experiments.  For example, in 1953 a field experiment was conducted specifically in order to provide data for a CORG game called SYNTAC. Hausrath remarked, "Here was an example of a game that established a requirement for field tests. The field tests in turn yielded data that enabled the game to solve problems not previously within the capability of operations research analytical study."[55]  The result became a standard resource for subsequent conventional war games. SYNTAC continued to be used to examine tactical problems through the middle 1950s, eventually acquiring computer support, making it the first Army computer-aided research game.[56]

The ORO created another gaming operation in order to generate data for its Intelligence Division, called INDIGO (Intelligence Division Gaming Operation).  INDIGO I was played in the spring and summer of 1958.  The data generated during the game took two years to process. While INDIGO had originally been developed in order to generate intelligence data, it subsequently became modified into a general use tactical game called TACSPIEL.[57]  TACPIEL was a "flexible, two-sided, free-play, manually operated, rigidly assessed, computer-assisted, division-level war game."[58]  It was oriented towards problems of ground combat such as "mobility, fire-power, communications, logistics, combat surveillance and target acquisition means, and air attack and defense."[59]

In September 1961, the Army established the Strategy and Tactics Group (STAG), under the supervision of the Deputy Chief of Staff for Military Operations.  STAG was a headquarters level gaming organization devoted to operational planning. Its games were generally mathematical, and often played on or  in conjunction with computers.[60]  On the other side of the gaming spectrum, the Army also carried on the tradition of gaming with miniatures.  The Combat Development Experimentation Center (CDEC) constructed "one of the world's largest terrain models."[61]  Following the practice of pretesting field exercises with gaming, gamers at the CDEC planned the details of data collection during field exercises

at the Army's field laboratory, Hunter Liggett Military Reservation. The terrain model was a replica of the field laboratory.  Hence it was hoped that there would be a close fit between the gaming experiments and their realization in the field. Moreover, at the end of the field exercises, the gamers would duplicate the scenario and replay various points of the game "for reexamination of critical and questionable areas."[62]

Joint Chiefs of Staff and NATO Gaming[63]

In spite of the many echelons of gaming in the various services, in 1961 the Joint Chiefs of Staff established its own Joint Gaming Agency.  A JCS official commented,

   The Joint Gaming Group was activated as a direct result of a recommendation made by a joint study group working on some complex general war problems. After examining various other analytical methods, the study group concluded that war gaming of the particular problem areas under investigation was required in order to evaluate the area more comprehensively. It was felt that Service war gaming was not sufficiently responsive to JCS policy and control. [64]

In its first year, while the JGA mostly requested games staffed by service personnel, the joint group did take part in the political crisis exercises conducted during the Berlin crisis.  In 1962, the JCS did begin the practice of ordering war games in response to specific requirements for data. "War games ... at the JCS level [were] used to analyze hypothetical situations as a part of studies more widely than to test actual plans."[65]  The gaming group was divided into three departments: General War, Limited War, and Cold War. "This organization was an acknowledgment that the Joint Chiefs of Staff interests in war gaming reached from one end of the conflict spectrum to the other."[66]  The following year, the group was reorganized as the Joint War Games Agency, and doubled its staff from 15 to 34 persons.

The general war division in conjunction with the Joint Strategic Target Planning Staff inaugurated an annual game of the current American strategic war plan. In order to simulate the Soviet side of the encounter, the JCS established a Red Planning Board, which devised a hypothetical first strike war

plan.[67]  The Red Planning Board consulted with analysts at the Defense Intelligence Agency, the National Military Command Systems Support Center, the Services, and the unified and specific commands. In light of the background materials supplied by these sources, and with reference to "assumed Red national objectives as approved by the Joint Chiefs of Staff,"[68] the Red planning board created a number of different first-strike war plans from which the annual game would be devised.[69]

Whereas the general war division commanded a great deal of support and was lauded as providing a substantive contribution to planning and analysis, the limited war division did not fare so well, nor was considered quite as effective. Rear Admiral Van Arsdall, Jr. commented, "This situation is directly traceable to the inherent uncertainties, the large number of variables and diversity of the forces involved in limited war situations, and the emphasis throughout the late 1950s on analyses of general nuclear wars."[70]  In the summer of 1962, the JSC authorized the development for a limited war game that could simulate land, sea, and air theater forces.

The Army's Strategic and Tactical Analysis Group was tasked to develop manual games for operational analysis in theater commands.  This resulted in the Master Battle Model, TBM-63, in 1963. TBM-63 was directed towards planning joint operations by the Joint Staff or Joint War Gaming group, however it was far too complex to yield useful and consistent results.[71]

We must also briefly mention NATO war games.  The US Army established a Special Weapons School for NATO forces in Oberammergau, West Germany as an adjunct to the Supreme Headquarters Allied Powers Europe (SHAPE). This training center was focused on training forces to fight in an atomic war.  In 1953, the school developed an Atomic Air-Ground War Game. Hausrath explained, "The game was to demonstrate some basic principles of tactical air operations in land warfare keyed to the tactical use of atomic weapons delivered by piloted aircraft in a limited or localized situation. Close coordination of air and ground forces .. was stressed in the game."[72]  The game was intended to train NATO forces how to attack enemy army units and airfields with tactical atomic weapons while "keeping from being annihilated."  (Hausrath added laconically, "An official report describing the purpose and nature of the game included the statement: 'No significance is to be attached to the outcome of this game.'"[73])

Finally, it is worth noting that in addition to simulating combat as such, specialized logistics games were conducted by the various services to train, evaluate, or plan for force support functions.  The members of RAND's logistics department designed an "inventory management" game called MONOPOLOGS in 1954.  The Army staged an annual logistics game including field exercises called LOGEX at Fort Lee from the early 1950s on.[74]  Similarly, the Army Management School, which had been established in 1954 at Fort Belvoir, Virginia, employed a series of logistics games in its curriculum: FORT IRWIN (1958), FORT

ROOT (1959), FORT SIMULATION (1960), the last item of which was programmed for the computer in 1961.  In 1957, the Army civilian contractor, RAC, established a group specifically devoted to gaming logistics.  By 1964, the logistics group had grown into a full-scale Logistic Simulation Division, focusing on manual games and computer simulations.[75]  Army logistics games spanned the various objectives of gaming, assessing current stock levels in warehousing and queuing games, training logistics officers, and planning future supply and management structures for possible operations or weapons systems.[76] The Army's other civilian research group, the ORO (which was still in operation, but parallel to RAC in function,) also staged logistics game, such as LOGSIM-W, which was a simulation game jointly designed by ORO consultants and officers of the Army Logistics Center at Fort Lee, Virginia in 1958-59.[77] Hausrath remarked, "MONOPOLOGS, FORT SIMULATION, LOGSIM-W and SIGMALOG represent games which were meeting grounds between the military... and business and industry with its newly developed interest in the gaming technique."[78]


Business Gaming[79]


Indeed, war-gaming was enthusiastically adopted by corporations and business schools almost at the same moment that the technique began to diffuse throughout the services in the late 1950s. RAND's inventory game, MONOPOLOGS appears to be one of the first logistics games to capture the imagination of business leaders.  When in 1956, the American Management Association sought to translate war-game design into business games, it hired as consultants and designers some members of the RAND logistics department. The AMA assembled a research group consisting of its own officials, the RAND consultants, operations analysts from management consulting firms, and programming experts from IBM.  The group called upon the war gaming staff at the Naval War College for instruction and suggestions.[80]  With help from IBM, the AMA group designed a model of idealized business transactions, which consisted of a series of formulae that captured the decision structure relevant to the growth and maturation of a firm. The resulting game, called "The Top Management Decision Simulation," was programmed for an IBM 650 computer, and presented to 20 corporation presidents in May 1957.  Very soon after, a computer-assisted game was created for the AMA Academy for Advanced Management, which was featured in the AMA Management Development Seminar and the Executive Decision Making Program. By March 1958, 350 corporation executives and 50 scientists and business school professors had played the game, and had declared themselves to be enthusiastic admirers of the technique.[81]


Like, war-gaming in its many modes of simulation, the story of business gaming is one of a vogue, and extraordinarily rapid diffusion.  While the AMA game achieved an almost instantaneous fame, it was a computer-assisted game.  Corporate executives clamored for a wholly manual, i.e. non-computer game. G. R. Andlinger and his associates in McKinsey and Company, Inc. anticipated this need.  Beginning in 1956, his team began to explore translating operational role-playing game design into business

scenarios, resulting in the "Business Management Game," which was released in 1957. In an article in the Harvard Business Review , Andlinger asserted,

Business gaming is the first promising attempt to provide this experience by simulating the real-life operations of a business and forcing the participants to cope with the same kind of problems that face the top management of a company....Operational gaming is essentially simulation and thus provides a framework for making trial-and-error decisions rather than for evolving an optimum strategy.[82]

He explained how simulation could impart valuable skills to the player. "It forces an over-all point of view...The need to exercise judgment an make decisions without 'complete' information is a powerful stimulus to mental discipline, decisiveness, and a healthy willingness to take risks."[83] Indeed, the integrative experience afforded the by game was precisely the quality singled out by a Vice-President of Sylvania's Electronic Systems Division, who remarked, " I believe one of the real values of the course is that it forces me to do more thinking about the interrelated aspects of my position and its responsibilities."[84]

Just as war-games were used for training officers at their bases and in the war colleges, business games were introduced into the curriculum of business schools. Thus, also in 1957, professors at the business school at the Carnegie Institute of Technology, devised the "Carnegie Tech Management Game" for use in the graduate curriculum. Similarly, that same year, professors at the Graduate School of Business Administration at UCLA designed the "UCLA Executive Decision Game."[85]

In this same period, just as the armed services gradually began to make use of simulations as part of their evaluation and planning practices, -- in addition to training, --

a few corporations began to experiment with gaming and simulation studies as a component of their operational planning. For example, as early as 1953, Lockheed established a systems planning department in its headquarters which employed electronic computers for such engineering tasks as computing trajectories, working out optimal designs for space vehicles. Within the decade, Lockheed's

Missiles and Space Division achieved some notoriety for its management games "that simulate[d] the business environment of the space industry; [in which] management teams represent[ed] imaginary competitive companies whose decisions [were] weighed by an appropriately instructed IBM [computer]."[86]  Likewise, in 1958, General Electric began to build a simulation laboratory which would duplicate all the operational tasks of a production division, i.e., "forecasting, production scheduling, inventory taking, distribution, and marketing." The state-of-the-art IBM 704 computer was programmed to compute "more than a thousand interacting variables -- things like prices, costs, stock levels, new orders, sales."[87]  By 1966, GE's simulation laboratory had become so integrated into its general planning procedure that a Naval Institute article that defended "the validity of war game analysis" commented casually, "Gaming before production has become accepted as an essential tool to management planning in much of industry."[88]  Some numbers will bear this out.  Hausrath gives the following data:

   • A Remington Rand Univac Survey reported that by August 1960, executives in 95 companies reported that business games were in use at their firm.[89]

   • The Boeing Airplane Company had incorporated games into its training program, by mid-1959, more than 2,000 management trainees had played a business game.

   • In 1960, more than 3,600 employees had played Minneapolis-Honeywell's in-house exercise, "Top Brass Game; 250 executives had played the Pillsbury in-house game.

   • By mid-1961, more than 15,000 lower and middle-level managers in the Bell Telephone Company had played the American Telegraph and Telephone Company's financial management game.

   • Moreover, executives went to the Army Management School for training: in September 1960, 600 men played the Army's logistic simulation LOGSIM;  264 others played the game FORT SIMULATION.[90]

Moreover, the STAG Directory of gaming organizations both within the armed forces and the private sector listed the following corporations that had established gaming facilities by 1961: Bendix Systems Division; The Boeing Company; Booz-Allen Applied Research, Inc.; Burroughs Laboratories; Chrysler

Corporation; General Dynamics/Electric Boat; General Dynamics/Fort Worth; General Dynamics/Pomona; HRB-Singer, Inc.; Hughes Aircraft; Lockheed Missiles and Space Company; Martin Marietta Corporation, Denver Division; Martin Marietta Corporation, Orlando Division; North American Aviation, Inc; Republic Aviation Corporation; Sylvania Electric Products.

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Peter P. Perla, The Art of Wargaming, Naval Institute Press, Annapolis, MD, 1990.

R.P. Rich, "Simulation as an Aid to Model Building," Journal of Operations Research, Vol. 3, no. 1, 1955.

David Alan Rosenberg, "The Origins of Overkill," International Security, Vol. 7, no. 4, Spring 1983.

United States Army, Strategy and Tactics Analysis Group (STAG), Directory of Organizations and Activities Engaged or Interested in War Gaming, Defense Documentation Center for Scientific and Technical Information, Cameron Station, Alexandria Virginia, no date but probably 1962.

Richard E. Zimmerman, "Simulation of Tactical War Games," in Charles D. Flagle, William H. Huggins, Robert H. Roy eds., Operations Research and Systems Engineering, The Johns Hopkins Press, Baltimore, Maryland, 1960.

[1]  The STAG Directory lists the following departments of the Navy or its civilian contractors that had conducted war-games by 1961: Office of the Chief of Naval Operations; Naval War College; Operations Evaluation Group, Office of Chief of Naval Operations; US Naval Weapons Laboratory, Dahlgren; US Naval Research Laboratory; Institute of Naval Studies; US Naval Command Systems, Support Activity, US Naval Weapons Plans; Planning Analysis Group, The Applied Physics Laboratory, Johns Hopkins University; Logistics Research Project, The George Washington University. United States Army, Strategy and Tactics Analysis Group (STAG), Directory of Organizations and Activities Engaged or Interested in War Gaming, Defense Documentation Center for Scientific and Technical Information, Cameron Station, Alexandria Virginia, no date but probably 1962. STAG had sent out a survey about interest in and extent of war-gaming to all services, non-profit contractors, and the defense industry. The directory resulted from the findings of the survey.


[2]  Peter P. Perla, The Art of Wargaming, Naval Institute Press, Annapolis, MD, 1990, page 106.


[3]  ibid., page 107.


[4] It was only in the late 1950s that a course, "Introduction to War Games" was added to the operations analysis curriculum of the US Naval Postgraduate School in Monterey, California. Francis McHugh, Fundamentals of Wargaming, United States Naval War College, Newport, Rhode Island, Third Edition, March 1966, page 4-3. Also see Joseph H. Engel, "Operations Research for the U.S. Navy Since World War II," Operations Research, Vol. 8, no. 6, November-December 1960.


[5] For the history of gaming at the Naval War College see McHugh, op. cit., pages 2-42-2-58.


[6]  For a description of Naval War College board games, see ibid., pages 4-10 to 4-24; for the description of a submarine tactical game, see ibid., pages 4-24-4-27.


[7]  ibid., page 4-34.


[8]  ibid., page 5-2.

[9]  ibid., page 5-4. For a description of the rooms and the command center, see page 5-6.


[10]  McHugh devotes a long chapter to NEWS. See ibid. pages 5-4 to 5-58.  Also see, "Navy Wargames gets new electronic touch," Business Week, November 15, 1958; "Electronic equivalent of war," Reporter, Vol. 19, December 11, 1958; "Fabulous 'War Game' Ready," Naval Aviation News, January 1959; Richard S. Brooks, "How it works -- the Navy Electronic Warfare Simulator," Proceedings of the US Naval Institute, Vol. 85, no. 9, September 1959; Commander Donald C Curran, "Educational War Games Played on the Navy Electronic Warfare Simulator" in Murray Greyson, ed., Second War Gaming Symposium Proceedings, Washington Operations Research Council, Washington DC, March 16, 17 1964, pages 49-54.


[11]  McHugh, op. cit., see pages 2-56-2-58.


[12]  McHugh, op. cit., page 5-3.


[13]  ibid., page 62.


[14]  Commander John B Davis, Jr., and Dr. John A Tiedeman, "The Navy War Games Program," Proceedings of the US Naval Institute, June 1960, Vol. 86, no. 6., page 63. The new department was called OP-06C, the Office of the Assistant to the Chief of Naval Operations for Naval War Gaming Matters. The Navy also built analogue simulators in addition to the NEWS.  For example, see "Ship motion simulator planned for Polaris," Aviation Week, Vol. 66, April 29, 1957; "Major parts being mated for Polaris ship simulator," Aviation Week,, Vol. 68, February 17, 1958; "Simulator cutting asw [anti-submarine warfare] training costs," Aviation Week, Vol. 77, September 24, 1962.


[15]  Davis and Tiedeman, op. cit., page 63.


[16]  See Lt. Col. WS Bartley, Chief, War Games Div. Marine Corps Landing Force Development Center in Murray Greyson, ed., Second War Gaming Symposium Proceedings, Washington Operations Research Council, Washington DC, March 16, 17 1964, page 131;  Maj. Edgar F. Musgrove, "No Game," The Marine Corps Gazette, August 1965.

[17]  McHugh, op. cit., page 4-2.


[18]  The STAG Directory listed the following Air Force offices (and AF contractors) involved in war-gaming as of 1961: Operations Analysis Office, Vice Chief of Staff HQ; Air Battle Analysis Division, Directorate of Plans, HQ; War Game Branch, Office, Assistant Chief of Staff for Intelligence; HQ, Air Force Systems Center; RAND; Laboratories for Applied Sciences, University of Chicago, Museum of Science and Industry; MITRE; Technical Operations, Inc.


[19]  One continuity between wartime operational research and later simulation was the orientation towards the system totality. Leroy A. Brothers describes the experiences of the Air Force operations analysts who worked with the Eighth Bomber Command in England in September 1942. He remarked, "The new analysts recognized at once that, in effect, the general had given them the whole bomber command as their laboratory." Leroy A. Brothers, "Operations Analysis in the United States Air Force," Journal of the Operations Research Society of America, Vol. 2, no. 1, February 1954, page 2. Also see Dr. James E. Lipp, "Development Planning -- Operational Research Aspects," and Dr. Joseph F. McCloskey, "Organization for Operations Research in the United States," in Max Davies, Michael Verhulst, eds., Operational Research in Practice, Pergamon Press, London, 1958.


[20]  George W. Morganthaler, "The Theory and Application of Simulation in Operations Research" in Russell Ackoff, ed., Progress in Operations Research, Vol. 1, John Wiley and Sons, New York, 1961, page 376.


[21]  For example, the Tactical Systems Laboratory of the Aeronautical Systems Division of Hughes Aircraft developed an computer simulation of air-ground combat; Republic Aviation Corporation designed an Aircraft Combat Operations Simulation Model which examined variables in tactical air warfare. In early 1960, North American Aviation planned three simulation laboratories to examine problems in limited warfare, command and control, and man-machine information management.  See STAG Directory, op. cit., pages 80, 90, and 84.  For Air Force analogue simulators, see G. L. Christian, "Link proposes ICBM training program," Aviation Week, Vol. 68, February 3, 1958; "Simulated manned missile flights facilitate evaluation of pilot role," Aviation Week, Vol. 68, February 10, 1958; M. Yaffee, "Chamber simulates space environment," Aviation Week, Vol. 70, April 13, 1959; "Space cabin simulator being built," Aviation Week, Vol. 70, June 22, 1959; C. Lewis, "Simulators train Mercury space pilot," Aviation Week, Vol. 71, August 17, 1959; D. Murray, "Amazing machines that makes believe," Coronet, Vol. 48, September 1960; "High Degree of Mission Realism is Feature of F-105D Simulator," Aviation Week, Vol. 75, August 14, 1961.

[22] There is some confusion about the year the project was initiated. Leon Feldman wrote, "The RAND Corporation in 1952 began research which led to the design of the Strategic Operations Model (later renamed Air Battle Model I), a detailed simulation of global air war." "Role of the Contractor and the User in Air Force War Gaming" in Murray Greyson, ed., Second War Gaming Symposium Proceedings, Washington Operations Research Council, Washington DC, March 16, 17 1964, page 107. On the other hand, Almon E. Daniels wrote, "Based upon some of the experience at RAND and stimulated by the interest of the Air Force Intelligence organization, the first research version of the Air Battle Model was completed and exercised at RAND in the summer of 1957 and then delivered to Headquarters, United States Air Force." Almon E. Daniels, "The User's Viewpoint on the Creation and Application of a Large Simulation Model," in John Overholt, First War Gaming Symposium Proceedings, November 30, 1961, Washington Operations Research Council, Washington DC, February 1962, page 85. The original Air Battle Model consisted of "a plan converter," i.e., instructions for translating war plans into programming language, the Air Battle Model, and the output programs. Garry Brewer and Martin Shubik, The War Game: A Critique of Military Problem Solving, Harvard University Press, Cambridge, 1979, page 130.


[23] Peter Perla, op. cit., page 123. Daniels moves this up to the summer of 1957.


[24] Almon Daniels, op. cit., page 85.


[25] Leon Feldman, op. cit., page 107.


[26] The RAND games, STRAW 1953, SWAP, 1959, and SAFE 1962 were introduced into the curriculum of the first class at the Air Force Academy. E. W. Paxson, War Gaming, RM-3489-PR, RAND, February 1963, page 17.


[27] Colonel Paul S. Deems, "War Gaming and Exercises," Air University Quarterly Review, Vol. 8, Winter 1956-57, page 106.


[28] SAGE's opening was reported in the public press. See "Two Hour Warning against Sneak Attack," US News and World Report, Vol. 43, September 6, 1957; "Sighting with SAGE," Newsweek, July 7, 1958; J. A. Fusca, "First SAGE direction center operating," Aviation Week, Vol. 69, July 7, 1958; "Simulation

facilitates integrating BOMARC control into SAGE system," Aviation Week, Vol. 69, November 10, 1958. For a history of SAGE, see Richard F. McMullen, The Birth of SAGE: 1951-58, Air Defense Command Historical Study, No. 33, 1965; Special Issue: SAGE, Annals of the History of Computing, Vol. 5, no. 4, October 1983; George E. Valley Jr, "How the SAGE Development Began," Annals of the History of Computing, Vol. 7, no. 3, 1985; Paul Edwards, The Closed World, MIT Press, Cambridge, MA 1996, pages 75-112; and Thomas Hughes, Rescuing Prometheus, Pantheon Books, New York, 1998, pages 15-68.


[29]  David Noble, Forces of Production, Alfred A. Knopf, New York, 1984, page 52.


[30]  Gilbert Burck, "'On Line' in 'Real Time'", Fortune, Vol. 69, no. 4, April 1964, page 144.


[31]  He elaborated the analogy, "This network, in effect, not only keeps the home office instantaneously aware of regional and system fluctuations in sales, costs, inventories, and profits, but takes the necessary steps to correct imbalances." Gilbert Burck, "The Boundless Age of the Computer," Fortune, Vol. 69, no. 3, March 1964,  page 108.


[32]  Burck, "'On Line' in 'Real time' ", op. cit., page 144.


[33]  ibid.


[34]  Richard Fryklund, "War 'Waged'; Air Force Computers Back Theory of Hitting Only Military Targets," Los Angeles Times, Sunday January 15, 1961, Section C, pages 1-3. It should be emphasized, however, that the target list exceeded 2500 separate entities in 1960. While the Fryklund article was based on an interview with AF Chief of Staff General Thomas White, SAC Commander General Thomas Power was hostile to reducing the target list to purely "counterforce" [ie military] targets. "When RAND strategist William Kaufmann visited SAC headquarters in the winter of 1961 to present a briefing on his ongoing study of counterforce, Power reacted with an angry cable to Chief of Staff White. The SAC commander wanted it made perfectly clear that Kaufmann's arguments did not reflect the current or future thrust of Air Force thinking." David Alan Rosenberg, "The Origins of Overkill," International Security, Vol. 7, no. 4, Spring 1983, page 67.


[35]  Deems, op. cit., page 109.

[36] STAG Directory, op. cit., page 86.


[37] ibid., page 87.  In 1948 and 1949, systems analyst Ed Paxson had directed operational gaming in a secret aerial combat research room, of which no documentation has been declassified.


[38] ibid.


[39] ibid.


[40] ibid., page 88.


[41] See Claude Baum, The System Builders: The Story of SDC, System Development Corporation, Santa Monica, California, 1981.


[42] The STAG Directory lists the following Army offices and civilian contractors involved in war-gaming in 1961: Army War College; Army Command and General Staff College; Army Air Defense School; Army Artillery and Missile School; Army Chemical Corps School HQ; Continental Army Command; Seventh US Army; Eighth US Army; Army Air Defense Command; Army Ordnance Missile Command; Army Combat Development Experimentation Center; Army Electronic Proving Ground; Ballistics Research Laboratories, Aberdeen Proving Ground; Army Security Agency Board; Army Chemical Corps Board, Board Army Chemical Center; Chief of Transportation, Department of the Army; Office of the Quartermaster General, Department of the Army; Army Aviation School, Fort Rucker; Army Ordnance Guided Missile School, Redstone Arsenal; CBR Weapons Orientation Course, Dugway Proving Ground; HQ, Army Alaska; HQ, Army Ordnance Weapons Command; Army Logistics Management Center, Fort Lee; Army Signal Air Defense Engineering Agency, Fort George G. Meade; USAMEDS Combat Development Group, Brooke Medical Center, Fort Sam Houston; Strategic Planning Group, Corps of Engineers, Army Map Service; Walter Reed Army Institute of Research, Walter Reed Army Medical Center; Human Resources Research Office, The George Washington University; Combat Operations Research Group; Research Analysis Corporation; Systems Research Group, Inc.; Management Research Group (Army Logistics Research Project), The George Washington University; Planning Research Corporation, Los Angeles.

[43]  Tin Soldier was made "operable" in 1952.  Alfred Hausrath, Venture Simulation in War, Business, and Politics, McGraw-Hill Book Company, New York, 1971, page 65.

[44]  Hausrath noted that the air defense model was programmed on and for the first model of the Univac computer. ibid., page 192, footnote 1.

[45]  One might argue that RAND Monte Carlo problems performed in the early 1950s might vie for the status of being the first computer wargame. One of the designers of the air-defense simulation, R. P. Rich, offered a paper describing the benefits of non-computer analogue simulators as well as war-games in a paper presented at the Session "On the Use and Value of War Game Methods in Solving Operations Research Problems" at the annual meeting of the Operations Research Society, on November 20, 1954. In the paper Rich defined a wargame as "just a special type of simulator, with the opposing teams so many parts of the machine." R.P. Rich, "Simulation as an Aid to Model Building," Journal of Operations Research, Vol. 3, no. 1, 1955, page 15.

[46] For a discussion of the early versions of Carmonette, see E. A. Adams, and R. D. Forrester, Carmonette: A Computer Combat Simulation, Operations Research Office, Johns Hopkins University, Washington DC 1959; and Hebron E. Adams et al., Carmonette: A Computer Played Combat Simulation, ORO-T-389, Operations Research Office, Johns Hopkins University, 1961.

[47]   Brewer and Shubik, op. cit., page 282.

[48]  Richard E. Zimmerman, "Simulation of Tactical War Games," in Charles D. Flagle, William H. Huggins, Robert H. Roy eds., Operations Research and Systems Engineering, The Johns Hopkins Press, Baltimore, Maryland, 1960, page 733.

[49] ibid., page 714.

[50]  ibid., page 760.

[51]  From 1952 through to 1961, ORO operations researchers struggled to maintain their analytic independence against the Army's service bias. In 1955, the Army terminated its contract with ORO, and established the Research Analysis Corporation (RAC) as a single-patron non-profit research corporation. ORO's director, Ellis Johnson complained, "The Army has wanted to run the research -- and that we couldn't tolerate." (From article in Missiles and Rockets, June 5, 1961, page 11. Cited in James R. Schlesinger, "Quantitative Analysis and National Security," World Politics, Vol. 15, no. 2, January 1963, page 313, footnote 17. Also see, Ellis Johnson, "The Long-Range Future of Operational Research," Operations Research, Vol. 8, January-February 1960.) The last major ORO project was the fourth of its series of reviewing continental air defense. ORO was finally shut down on August 31, 1961. Its work was transferred in toto  to RAC.  RAC's contract with the Army extended from 1951 through September 1972. Brewer and Shubik, op. cit., page 66. Also see W. L. Whitson, "The Growth of The Operations Research Office in the U.S. Army," Operations Research, Vol. 8, no. 6, November-December 1960.


[52] STAG Directory, op. cit., page 58.


[53]  See Dr. F. C. Brooks and Colonel L. W. Merriam, "CORG Plans Tomorrow's Army Today," ARMY, February 1956. Relevant publications from CORG are: War Gaming Manual, 1 March 1956, SECRET; John P Young, A brief history of war gaming,  October 18, 1955; James B Hodgson, Jr., Hexpiel, An essay at a large unit Tactical War Game, CORG-M-57, January 12,1957; James Hodgson, A Generalized Analysis of War Gaming, CORG-M-66, April 5, 1957. When ORO's contract was terminated, the civilian contractor, Technical Operations, Inc. assumed the supervision of CORG. A fire at the CORG office destroyed all the records including the first 25 staff memoranda.  Hausrath's account was based on the memory of CORG veteran members. Hausrath, op. cit., page 69.


[54]  Lieutenant General Gordon B. Rogers, "Battles Without Bloodshed," Army Information Digest, Vol. 15, no 12, December 1960, page 35.


[55]  Data was needed concerning the exact location and intensity of fire from an anti-tank weapon. Hausrath, op. cit., page 71.


[56] ibid., page 146.


[57]  ibid., page 132-4.

[58]  ibid., page 173.

[59]  ibid. Also see Edward Girard et al., TACSPIEL War Game Procedures and Rules of Play, (U), RAC-TP-111, Research Analysis Corporation, November 1963, SECRET.

[60]  The STAG directory noted that in 1962, a liaison officer of the US Army Chemical Corps would placed on duty to the CONARC War Games Division in order to help integrate chemical and biological warfare into CONARC games. STAG Directory, op. cit., page 41.

[61] Colonel Alfred W. DeQuoy, "Operational War Gaming," Armor, Vol. 72, September-October 1963, page 33.

[62]  ibid., page 34.

[63]  The STAG Directory listed the following war-gaming activities associated with the Joint Service Agencies as of 1961: Joint War Games Control Group, Joint Chiefs of Staff; Staff Commander in Chief, Pacific; Supreme Headquarters Allied Powers Europe; Weapons Systems Evaluation Group, Office of the Director of Defense Research and Engineering; Research and Analysis Division, Defense Atomic Support Agency.  Also see George E. Pugh, "Operations Research for the Secretary of Defense and the Joint Chiefs of Staff," Operations Research, Vol. 8., no. 6, November-December 1960.

[64]  Rear Admiral Clyde Van Arsdall, Jr., "Joint War Games," in Murray Greyson, ed., Second War Gaming Symposium Proceedings, Washington Operations Research Council, Washington DC, March 16, 17 1964, page 120.

[65]  ibid., page 118.

[66]  ibid., page 121.

[67]  Van Arsdall, Jr. stressed, "The importance of [the Red war plan] cannot be over-emphasized inasmuch as all game results are a direct consequence of the hypothetical  Red attack." ibid., page 124.

[68]  ibid., page 125.

[69]  "Our board .. assumes the role of Red planners and attempts to apply the estimated Red force in an integrated hypothetical war plan. These plans are not held forth as the way  Red will use his forces. Rather, it is merely stated that the plans are one  rational, militarily feasible way in which Red could use his forces." ibid., page 123.

[70]  ibid., page 125.

[71]  STAG Directory, op. cit., page 167.

[72]  Hausrath, op. cit., page 131.

[73]  ibid., pages 131-132.

[74]  Hausrath, op. cit., page 193, footnote 2.

[75]  Martin W. Brossman, "Logistics Games" in Murray Greyson, ed., Second War Gaming Symposium Proceedings, Washington Operations Research Council, Washington DC, March 16, 17 1964, page 77. See pages 79-103 for discussion and examples of logistics games.

[76]  ibid., pages 77-78.

[77]  Hausrath, op. cit., page 193.

[78]  ibid., page 194.


[79]  For more on business gaming see R. Bellman, C. Clark, D. Malcolm, F. Ricciardi, "On the Construction of a Multi-Person, Multi-Stage Business Game," Operations Research, Vol. 5, 1957; R. Bellman, "Top Management Decision and Simulation Processes," The Journal of Industrial Engineering, Vol. 9, No. 5, September-October 1958; American Management Association, Simulation and Gaming, Management Report No. 55, 1961.


[80]  Hausrath, op. cit., page 194. Unless otherwise noted, the following account is based on Hausrath, pages 192-198.


[81]  Among the corporation presidents who played the game were Don Mitchell of Sylvania who declared "I'd like to play it once a year,"; Alfred Perlman of the New York Central [Railroad], Patrick McGinnis of the Boston & Maine; Wayne Holman Jr. of Chicopee Mills. John McDonald and Franc Ricciardi, "The Business Decision Game," Fortune, Vol. 57, no. 3, March 1958, page 140.


[82]  G. R. Andlinger, "Business Games -- Play One!," Harvard Business Review, Vol. 36, no. 2, March-April 1958, page 115.


[83] Andlinger, op. cit., page 125.


[84] McDonald and Ricciardi, op. cit., page 214.


[85] Hausrath, op. cit., page 211.


[86]  Burck, "'On Line' in 'Real Time'", op. cit., page 246.


[87]  "The Gentle Art of Simulation," Business Week, November 29, 1958, page 73.

[88] Captain James T. Cockrill, "The Validity of War Game Analysis," Proceedings of the US Naval Institute, Vol. 92, no 1, January 1966, page 47.


[89] Hausrath, op. cit., page 197.


[90] ibid., page 198.