Analysis in the Utility of Commercial Wargaming Simulation Software for Army Organizational Leadership Development

A Monograph
by

Major Kerry MacIntyre
Ordnance Corps

School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas
Second Term AY 99-00

DTIC QUALITY INSPECTED 4

20000919 096

Analysis in the Utility of Commercial Wargaming Simulation Software for Army Organizational Leadership Development by MAJ Kerry J. MacIntyre, USA, 56 pages.

As a result of the growing capabilities of computers, the Army has used wargaming increasingly for training and education activities, force planning, doctrine development, acquisition and cost analysis, operational test and evaluation, and campaign development. The intent of this monograph was to determine if commercial wargame simulations could be used to develop the organizational leadership abilities of Army officers.

The initial step in this process selected commercial wargame simulations to evaluate for their ability to develop organizational leaders. Chapter two of this monograph discusses the history of simulations, the simulation selection process, and provides an overview of the simulations selected. This monograph then evaluated each simulation's ability to develop the four organizational leadership skills (interpersonal, conceptual, technical, and tactical) and to perform the three organizational leadership actions (influencing, operating, and improving) described and required by Army doctrine. The final chapter of this monograph concluded with a recommendation to use commercial simulations for developing organizational leadership skills, and suggested some commercial wargame simulations for future evaluation and possible integration into leadership training plans.

This study suggests, from the ability of the small sample analyzed to meet the criteria, that it may be possible to the Army to use commercial simulations to help develop organizational leader skills and actions at a reduced cost.

Contents

Chapter 1: Introduction	1
Chapter 2: Defining the Simulations	8
Chapter 3: Criteria for Evaluation	19
Chapter 4: Analysis of the Simulations	27
Chapter 5: Conclusions and Recommendations	49
Endnotes	52
Bibliography	57

Chapter 1: Introduction

Credit for originating the wargame is given to the Prussians. In 1811 Herr von Reisswitz of Berlin received Prussian royal patronage for his newly invented wargame. This game evolved around realistic moves, a relief model and individual game pieces that represented units and troops. –Mr. Robert Chicchi, Center For Strategic Leadership, United States Army War College.[1]

Background

As a result of the growing capabilities of computers, the Army has used wargaming increasingly for training and education activities, force planning, doctrine development, acquisition and cost analysis, operational test and evaluation, and campaign development. Wargames are also used as operational planning devices; however, the most common use of wargames is for the education and training of military force leaders. In training programs, wargames are used for education, exploring alternatives, providing insights, practicing decision making under a variety of situations, and generating discussions.[2]

Commercial simulations are a potential means of conducting Army leader training and education within resource constraints. Resources continue to grow scarcer as training needs become more critical throughout the department of defense, as noted by James Fernan in his master's thesis at the Air Force Institute of Technology:

> High quality and cost effective training is more important today than ever before due to the downsizing of the military, the increased pressure to reduce defense spending, and the continuing competition for scarce resources. These scarce resources of maneuver space, dollars, and training time play a major role in determining the quality and type of training

a unit is able to conduct.[3]

The Army faces these same issues. Using existing commercial simulations, saving the Army development and production costs, to develop Army leaders both individually and in staff exercises (further saving operational dollars by not deploying entire organizations) could allow this leadership development without further draining scarce Army resources. The Army does not currently have a doctrinal standard for the use of commercial simulations, although several Army institutions do use them in a relatively minor role.[4]

Defining the Problem

Army leadership development is built on a foundation of three platforms; values and ethics, expectations and standards, and training and education. Leaders are educated in these areas through self-development, attendance at institutional schools, and assignments in operational units. Leaders learn the actions, skills and attributes needed in Army leaders by these education methods.[5]

In the Army leadership framework, a leader must possess character, competence and ability to act. Army values and attributes define the leader's character. Leader competence is the skills that the Army leader must have. Army doctrine divides these skills into four categories: interpersonal skills, conceptual skills, technical skills and tactical skills. The Army leadership framework concludes that to be successful a leader must take action. These actions can be divided into three categories: influencing actions, operating actions, and improving actions.[6] As a leader matures and assumes more

advanced leadership positions, he must master additional skills in each category. There are three levels of Army leadership positions: direct, organizational, and strategic.[7] This Army leadership framework formed the basis for this monograph's evaluation of commercial wargaming simulations.

This monograph focuses on the ability of commercial wargame simulations to develop organizational leadership skills and actions as defined by Army leadership doctrine in Field Manual 22-100, *Army Leadership*. Organizational leaders use individual leadership tasks to

> influence several hundred to several thousand people. They do this indirectly, generally through more levels of subordinates than do direct leaders. The additional levels of subordinates can make it more difficult for them to see results. Organizational leaders have staffs to help them lead their people and manage their organizations' resources. They establish policies and the organizational climate that support their subordinate leaders.[8]

Organizational leaders are concerned with the integration of systems. They focus on planning and the integration of operations throughout their organization. Organizational leaders have a requirement to integrate the input of information from a variety of sources, and apply accurate decision making skills. Organizational leaders must "deal with more complexity, more people, greater uncertainty, and a greater number of unintended consequences. They find themselves influencing people more through policymaking and systems integration than through face-to-face contact."[9] Army doctrine separates required organizational leader abilities into two areas: skills and actions.

Organizational leadership skills are further divided into four categories: Interpersonal skills, Conceptual skills, Technical skills, and Tactical skills.

Interpersonal skills include teambuilding, communicating and supervising. Conceptual skills are the ability to identify and frame complex problems and use a systemic approach to problem solving. This includes reasoning and critical thinking skills, communicating intent, filtering and processing information, and systems understanding. Technical skills include resourcing, prioritizing, evaluating second and third order effects, and assessing. Tactical skills at the organizational level are those of synchronization and orchestration. An organizational leader with the appropriate tactical skills view the effects of time on decision sets and take the correct required action.[10]

Organizational actions are divided into three categories: Influencing Actions, Operating Actions, and Improving Actions. Influencing actions are achieved by communicating, decision making and motivating. Operating actions are the applications of systems planning, executing and assessing. Improving actions are what the leader does today to make the organization and subordinates better tomorrow.[11]

Research Question and Methodology

The intent of this monograph is to determine if commercial wargame simulations could be used to develop the organizational leadership abilities of Army officers.

The initial step in this process selected commercial wargame simulations to evaluate for their ability to develop organizational leaders. A variety of commercial simulations were available on the market for evaluation. These games were produced for the express purpose of generating earnings for the

producing corporation, not satisfying military training objectives. Mr. J.C. Fernan, in researching his master's thesis "Gettysburg, an Analysis of the Training Value of Commercial Models", realized that

> game designers create models from historical data and events but with a specific objective in mind. The faithful representation of the historical event may conflict with requirements of flexibility, marketability, or proponent desires.[12]

Chapter two of this monograph discusses the history of simulations, the simulation selection process, and provides an overview of the simulations selected. This monograph then evaluates each simulation's ability to develop the four organizational leadership skills (interpersonal, conceptual, technical, and tactical) and to perform the three organizational leadership actions (influencing, operating, and improving) described and required by Army doctrine. The intent of the monograph is not to determine which of the four simulations selected is the best at developing organizational and leadership skills. The intent is to explore the possibilities of using commercial simulations to develop organizational leaders, using a representative sample of the simulations commercially available to evaluate possibilities.

The final chapter of this monograph concludes with a recommendation to use commercial simulations for developing organizational leadership skills, and suggests some commercial wargame simulations for future evaluation and possible integration into leadership training plans.

Significance

The organizational leadership level was selected as the appropriate level for analysis of the commercial simulations because this leadership level is most applicable to division and corps level planners, staffs and commanders. Chapter three defines doctrinal organizational leadership skills, the applicability of these skills to division and corps level commanders, staffs and planners, and the ability of commercial simulations to develop these organizational leadership skills. Chapter four defines doctrinal organizational leadership actions, the applicability of these actions to division and corps level commanders, staffs and planners, and the ability of commercial simulations to develop these organizational leadership actions.

Assumption

The simulations selected, where applicable, are assumed in general to be historically realistic. This monograph does not attempt to evaluate the infinite details associated with the historical accuracy of the commercial simulations used. For example, this monograph does not attempt to determine if the range of the artillery pieces in *The Operational Art of War* matches the current statistical data as listed by Jane's Information Group Limited in *Jane's Defense Weekly.*[13] The simulations are assumed to be accurate enough to facilitate evaluation of the skills and actions defined in the Army doctrinal leadership framework.

Scope

The focus of this monograph is on the development of officers and their subordinate units. While much of this research could apply to the development of the non-commissioned officer corps, this monograph does not intend to explore this except where such development is inextricably linked to the officer development.

This monograph does not evaluate the impact of commercial simulations on leader character development because the author could not, through personal exploration, informal conversations with avid wargamers, and reviews of wargames, locate any commercial simulations whose software attempted to model the moral, ethical and valuation judgments of leader actions. The wargaming simulations that were examined were not vehicles for building leader values, ethics, expectations or standards.

Constraints

The Army has designed and built many simulations for training and evaluation of Army organizations and leaders. Army simulations take time to develop, and usually incur large costs in the development and production process. The intent of this monograph is to locate simulations already developed and produced in an effort to conserve Army resources. Additionally, Army simulations are developed specifically to train and develop organizational leaders such as commanders, staffs and planners. Therefore, this monograph does not include consideration of simulations specifically designed for and currently in use by the Army.

Chapter 2: Defining the Simulations

"Of all the games covering World War II (board and computer), the Pacific War as a whole is by far the least well represented. When you first start playing Pacific War, you'll understand why...it is an enormous and sometimes daunting proposition to attempt to manage a war covering so much area." - David Kurtz, Review of Pacific War[14]

History of Simulations

The first attempts at wargaming began in the nineteenth century, when the Prussians first used terrain models and game pieces to represent military forces in action. The Germans later developed this concept into a wargame known as *Kriegsspiel*, eventually adding additional rules and computations, and requiring expert umpires who judged the legitimacy of moves and the outcome of conflicts.[15] The use of wargaming in the United States began in the 1870's when an Army major attempted to develop games that did not require expert monitoring, as the Army did not have the requisite experts to monitor the games.[16] Despite these efforts, the Army continued to use the "free Kriegsspiel style" throughout World War I and II.[17] During World War II, the military began to incorporate scientific methods of experimentation in these wargames. This led the post World War II era military to develop and use the war game to conduct operations research and systems analysis rather than to replay past military campaigns. This preoccupation led the military away from the study of military history, and only recently has there been a return.[18]

Civilian wargames also descended from the original chess games, and by the seventeenth century had approached modern complexity, although not as accurate as military wargames. Most wargames focused on single battle

scenarios that were less a game than a "paper shuffling exercise directed toward solving the puzzle of getting all the pieces moving at the right place and time, much like planning a railroad schedule."[19] Civilian wargaming, however continued to grow. In 1953, Charles Roberts developed the game *Tactics,* frequently recognized as the first modern commercial war game. The popularity of this game led to publishing of additional board based wargames in the early 1960's, including the original *Gettysburg*, and the foundation of a large commercial gaming community that included publishing companies, including as Avalon Hill and Simulations Publications, gaming magazines, and models. The industry spawned other types of games, including as role playing games, in the science fictions and fantasy genre, that eventually became more popular than the original war games. The peak of this industry was in the 1970's following the publication of Gary Gygax's *Dungeons and Dragons*. The 1980's saw the end of this boom in gaming, an end that could have relegated the war game to the dusty back shelves of a few hobbyists. However, the commercial war game was saved by the introduction of technology-the personal computer.[20]

The invention of computers with advanced mathematical capability forever changed the face of wargaming. The first commercial computer wargames were produced circa 1977 and made to run on whatever machines were available-usually the cheapest and most widely sold.[21] International Business Machines changed the face of computing in 1981 when they introduced the personal computer with 256K of memory and the floppy disk. This allowed paper based war games to be converted to electrons. Computer war games had the

advantage of easily computing mathematical formulas to determine conflict outcomes and the conduct of operations. Many former paper war gamers did not like this, as they could not set the engagement rules to suit their particular beliefs.[22]

Amateur university students developed the earliest known computer wargames, while the military paralleled this computer wargame development with a professional staff. Credit for the first computer wargame goes to Steve Russell of Massachusetts Institute of Technology (M.I.T.) for his game *Space War* in 1961. At this time the Army was also developing *ATLAS*, a theater level model of war between NATO and the Warsaw Pact. It was ten years later before the first computer wargames were available commercially. Professional and amateur wargame creators continued to develop. The first tank simulator appeared in 1977. Developed for the US Army Armor School at Fort Knox, "*Panzer Plato* was an accurate simulation of armored vehicles."[23] The first commercially published wargame, *TANKTICS* was also first available in 1977. By the 1980's wargames began to differentiate into categories. Atari's game console gave rise to the arcade wargame, which focused on hand-eye coordination to rapidly defeat enemy forces. The birth of the personal computer (PC) gave rise to map based campaign war games, such as *Eastern Front 1941*. The first flight simulator was also created in 1980. Today the war games commercially available fall into the following categories: role-playing- 33%; action arcade-20%; simulator (ie flight or tank) 25%, other: 12% wargames: 10%. The 1990's experienced exponential leaps in the PC's computer power. This allowed

wargames to add additional features to the traditional scrolling maps and set icons. Artificial intelligence made games more interesting by creating a more intelligent opponent. Increased speed and capacity allowed for more detail. Users gained access to the game parameters, enabling players to set the conditions for play. Improved graphics and sound technology made game playing experiences more realistic. Hypertext allowed players more background information.[24]

Defining Wargames, Models and Simulations

War-oriented commercially available computer programs are often randomly and interchangeably referred to as historical models, computer simulations, or most commonly, wargames. Historical models are used to "represent the reality of a real system by duplicating its important features, appearance, and characteristics."[25 26] There are a variety of types and categories of models; of those available, commercial wargame software most closely resembles those known as behavior models and decision support systems.[27 28] Computer simulations, like models, "attempt to duplicate the features, appearance and characteristics of a real system."[29] There are many types of simulations found in the commercial sector; commercial wargaming simulations are categorized as military applications.[30 31] The wargame combines aspects of both models and simulations.[32] Wargames are defined as "historical accounts of an event in simulation form."[33] The wargame presents the situation so that the player can manipulate the key elements. This allows users to better understand how all these elements interacted, and gives players the opportunity

manipulate the effects of alternative strategies and tactics.[34] The computer programs used in this monograph contained elements of and bore similarity to models, simulations and wargames. For the purpose of this monograph, the terms defined above will be used interchangeably.

Selection of Simulations

The intent of this monograph was to select strategy oriented simulations from commercially available wargames. Games were only considered if they addressed the challenges of command and control in a given battle space, since the intent of the monograph is to address the educational and training needs of Army organizational leaders. As a result, all arcade type wargames, equipment simulators, and role-playing games were eliminated. The remaining strategy based wargames available for consideration were too many to analyze in the amount of time available to conduct research for this monograph. To select simulations for this monograph, the author first examined a selection of available wargames to determine what the games had in common and how they differed. Next, the author used the similarities and differences to establish criteria for selection. Finally, the author determined how many of the simulations could be evaluated based on the time available in which to conduct research, and selected the simulations for evaluation.

An examination of twenty wargames commercially available revealed several core commonalties and significant differences. The author used these to create game categories by which the games could be classified. The first category was historical content. Each of the games examined addressed either

a single historical period or multiple historical periods. Additionally, some games adhered strictly to their historical charter, while others allowed the user to postulate imagined or future scenarios, or to create an original. The second category was span of control, which was defined as the level at which the player controlled the game. Span of control ranged from squad sized elements consisting of five to ten men and their equipment, to several countries' military forces. The third category was the scope of the battlefield, which was determined by the size of the battlefield and the mix of military forces available. The games examined ranged from a twenty square mile battlefield with land forces only to a six thousand square mile battlefield with land, air and sea forces available.[35]

These categories of the similarities and differences between the commercial simulations were used to create criterion to select the simulations for analysis. The first criterion was the number of historical periods addressed. As a minimum, one game selected must address only one historical period, and at lone must address multiple historical periods. The second criterion was the creativity of the games. One game selected must have the ability to play postulated historical games and the ability to create imaginary scenarios. The third criterion was unit size. Simulations had to support at least brigade sized units and higher. Smaller units, such as companies and battalions, could be simulated and manipulated in the wargame, but no games could be selected in which did not support at least brigade level battles. The fourth criterion was level of war. One game selected must simulate the tactical level of war, one the

operational level of war, and one the strategic level of war. The fifth criterion was forces available. One game should conduct operations with combined arms forces, and one game selected must operate with joint (air, land and sea) forces.[36]

The games selected were Sid Meier's *Gettysburg!*, Gary Grigsby's *Steel Panther's III,* Norm Koger's *The Operational Art of War Volume II, and Gary* Grigsby's *Pacific War.* Sid Meier's *Gettysburg!*, focused on one historical period, and did not have the ability to create scenarios. *Gettysburg* supported brigade battles at the tactical level of war. Combined arms operations were limited to infantry and artillery interaction, and it did not support joint operations. Gary Grigsby's *Steel Panther's III* supported multiple historical periods and had the ability to create scenarios. *Steel Panther's III* supported brigade battles at the tactical level of war. Combined arms operations were limited to infantry, armor and artillery interaction. *Steel Panther's III* did not support joint operations. Norm Koger's *The Operational Art of War Volume II,* focused on multiple historical periods and allowed the user to create notional scenarios. *The Operational Art of War* allowed user control of divisions at the operational level of war. It supported combined arms operations between infantry, armor, artillery and aviation, as well as user control of joint forces. Gary Grigsby's *Pacific War* concentrated on one historical period and did not have the ability to create scenarios. Users controlled multinational armed forces at the strategic level of war. *Pacific War* supported combined arms and joint operations.[37]

Overview of Simulations

Gettysburg

Sid Meier's *Gettysburg* was based on the civil war battle of the same name. It supported individual play against the computer or allowed for up to eight multiplayer and Internet players. Users controlled leaders and units at the battery, regimental and brigade levels. Short tutorial scenarios were available to facilitate the quick learning process. The game came with twenty-five predesigned scenarios that ranged from the historical to the "what if" possibility scenarios. Campaign games linked nine different scenarios so that the entire three-day campaign could be played; it adjusted the campaign based on successes and failures, so the campaign constantly changed. This did not make *Gettysburg* an operational level of war game as the campaigns were linked but not related to each other. *Gettysburg* had four levels of difficulty, and various speed settings that helped challenge players of the game. The computer as an opponent in this game was able to adapt to the user's techniques by identifying and exploiting weaknesses.[38] Players could choose which side to control. All games could be replayed.

Steel Panthers III

Steel Panthers III covered the historical period between 1939 and 1999. The game supported individual play against the computer or two-player games in a battle or by email. Players commanded a brigade sized land element of which the smallest unit is a platoon of 20-50 men with two to five vehicles and two to three guns. Users controlled units down to the squad and team level as desired, or moved units as formations. *Steel Panthers III* took three to six hours to

adequately learn the basic of play; the game included a twelve turn tutorial to facilitate this process. The game was preloaded with forty scenarios from World War II, Korea, Vietnam, Africa, Afghanistan, Desert Storm, and Chechnya. Some are speculative: for example Poland 1999 postulated a 1999 German invasion of Poland. Players could choose to play either side. In addition to the pre built scenarios, *Steel Panthers III* had six campaigns. Three of the six campaigns, North Africa 1941-1942, Stalingrad 1942, Market Garden 1944, and Vietnam 1964-1971, were historically based, although outcomes of game play of course differ from historical results.[39] Notional campaigns included a 1988 Russian Invasion of West Germany and a Middle Eastern conflict (Holy War 2000). *Steel Panthers III* contained a multitude of options that can made play more difficult or simple for the user. Play opened with user selection of a battle, scenario or campaign, or choosing to design a custom scenario.

Operational Art of War Volume II

The Operational Art of War Volume II was a historical game that portrayed historical battles from 1956 to today. It supported individual play against the computer, two player game play, or playing by email. Units ranged from platoon level to corps, and users could fight company through corps level actions. Game turns were adjusted to run from six-hour time periods to complete weeklong time segments. *The Operational Art of War Volume II* emphasized air and land operations. Although not truly operational in the sense that the user had only limited control over theater level flow operations, the game did address some combined arms, joint aspects and civil military affairs issue that made it more

than a tactical level game. Combined arms and joint operations were especially critical to success. The game had some historical scenarios, but focused more on hypothetical ones. Scenarios ranged from 1956 operations to futuristic battles. Historical games included two Vietnam scenarios, Ia Drang 65 and Bong Son '66, and a Yom Kippur scenario, Middle East 73. Interesting notional games preloaded included a U.S. invasion of Cuba in 1962, a Warsaw pact attack against NATO forces in both 1976 and 1984, a second Korean war scenario that took place in 1999, a 1962 World War III concept and Chinese-Soviet Union clash along the Anur river.

Pacific War

Gary Grigsby's *Pacific War* recreated the Pacific Theater during World War II. It supported individual play from either side, or two player games either at one console or via email. Depending on what scenario was played, *Pacific War* took from 50 hours to 250 hours to play. *Pacific War* had a steep learning curve. A tutorial helped facilitate the learning process, but did not negate the difficulty in learning to play this game. *Pacific War* maintained a strategic focus, leveraging personnel and equipment to conduct operations and missions. The level of detail found in *Pacific War* was extensive. Each ship, air group and land combat group was represented. Additionally, most of the key senior leaders were present, with their unique characteristics accounted for to influence game play. *Pacific War* included five scenarios that covered the beginning, middle or end of the war, as well as two campaigns covering the entire war.

Chapter 3: Criteria for Evaluation

When you took your oath, when you agreed to be a leader, you entered into a pact with your subordinates and your nation. America has entrusted you with its most precious resource, its young people. Every person serving with you is someone's son or someone's daughter, a brother, mother, sister, father. They are capable of extraordinary feats of courage and sacrifice—as they have proven on GA MacArthur's hundred battlefields and on every battlefield since then. They are also capable of great patience and persistence and tremendous loyalty, as they show every day in thousands of orderly rooms and offices, in tank parks and on firing ranges around the world. They show up and they do the work, no matter how frightening, no matter how boring, no matter how risky or bloody or exhausting. And what they ask in return is competent leadership-Field Manual 22-100, Army Leadership[40]

Methodology

This chapter developed the criteria used to evaluate the ability of commercial simulations to develop organizational leadership. The criteria used to evaluate the commercial simulations were based on the categories of doctrinal organizational leadership skills, interpersonal, conceptual, technical and tactical, and the organizational actions, influencing, operating, and improving, as defined in FM 22-100, *Army Leadership*. The methodology for developing the criteria for evaluation was as follows. The author first listed all of the tasks associated with each organizational leadership skill or action category. Next, the author compared each category's tasks, looking for specific tasks that reoccurred between the categories. The author then identified the common tasks that reoccurred with the most frequency between categories, and compared these to the tasks recommended in FM 101-1 *Staff Organization and Operations*.[41] This comparison was conducted so that the author could ensure that the tasks

aligned with the key tasks of commanders, staffs and planners. The reason for this comparison was that the purpose in analyzing the organizational level of leadership was to ensure that the analysis applied to commanders, staffs and planners. Finally, the four most frequently cited tasks were selected as the criteria for evaluation of the simulations. These criteria were as follows:

1. The simulation taught organizational leaders to process information.
2. The simulation taught organizational leaders to identify the problem to be resolved.
3. The simulation taught organizational leaders to understand the interrelationships of systems.
4. The simulation taught organizational leaders to identify the solution.

The reasons for selecting only four criteria were as follows. First, the four criteria selected incorporated the most frequently occurring tasks all of the organizational skills and actions categories in FM 22-100 and were identified as specified tasks of commanders, staffs and planners in FM 101-5. The author felt that these criteria were the most critical because of their consistent appearance in both manuals. Second, four criteria were the maximum number that the author was able to address in the amount of time available to analyze the four simulations' ability to perform.

Criteria One: The simulation taught organizational leaders to process information.

The first criterion determined the simulation's ability to teach organizational leaders to process information. Developing the ability to process

information was one of the key tasks necessary in the development of interpersonal, conceptual, technical and tactical organizational skills. To develop interpersonal skills, the organizational leader needed to evaluate feedback information from his subordinates in order to supervise his organization. In developing conceptual skills, the organizational leader needed to request the information appropriate to a specific problem and filter the information received for its applicability to the problem. To develop technical skills, the organizational leader needed to prioritize information in order to resource the missions of the organization. When developing tactical skills, the organizational leader needed to learn to quickly obtain accurate information in order to orchestrate or synchronize his unit's operations.[42]

Processing information was also a key task to be performed in influencing, operating and improving actions. The organizational leader's influencing actions included translating the available information into a definition of the problem and proposed solutions. The organizational leader's operating actions included gathering and filtering information in order to assess forces and to conduct systems planning and preparation. Finally, organizational improving actions included selecting critical information in order to improve organizational processes and programs.[43]

The simulations evaluated were considered successful in this criterion if they met the following measures of success. First, the simulation required the user to filter a variety of information in order to determine which information was important to the success of the operation. This required the simulation to

provide data that was and was not applicable at any given moment in the operation. Second, the simulation required the user to prioritize the information available by varying the applicability of the information provided to different aspects of the operation.

Criteria Two: The simulation taught organizational leader to identify the problem to be resolved.

The second criterion determined simulation's ability to teach organizational leaders to identify the problem to be resolved. Developing the ability to identify the problem that needs to be resolved was a key task in developing interpersonal, conceptual, technical and tactical organizational skills. In developing interpersonal skills, organizational leaders needed to identify problems as order to communicate their intent to the unit. To hone conceptual skills, the organizational leader needed to develop critical thinking that included complex problem solving and reasoning. In order to develop technical skills, the organizational leaders needed to clearly identify problems to develop their resourcing skills. When developing tactical skills, the organizational leader needed to learn to identify problems to be able to synchronize or orchestrate the response of their organization to the problem.[44]

Identifying the problem was also a key task to be performed in influencing, operating and improving actions. The organizational leader's influencing actions included the ability to identify the problem as the first action taken in making decisions. Organizational leaders operating actions required the leader to identifying the problem when defining objectives. Finally, organizational

improving actions included required the leader to identify problems as the first step in focusing changes to the organization.[45]

The simulations evaluated were considered successful in this criterion if they met the following measures of success. First, the simulation required the user to conduct a mental mission analysis. The simulation could not tell the user specifically what problem needed to be solved. Second, the simulation needed to require the user to establish an endstate. This meant that the simulation required the user to mentally determine what the battle space should look like at the end of the operation in order to focus his organization on objectives and goals for the scenario.

Criteria Three: The simulation taught organizational leaders to understand the interrelationships of systems.

The third criterion determined simulation's ability to teach organizational leaders to understand the interrelationships of systems. Developing the ability to understand the interrelationships of systems was a key task in developing interpersonal, conceptual, technical and tactical organizational skills. In developing interpersonal skills, organizational leaders needed to understand the interrelationship of systems in order to know how, when and what to communicate. To sharpen conceptual skills, the organizational leader needed to understand systems in order to establish intent and to develop critical thinking and reasoning skills. In order to develop technical skills, the organizational leaders had to understand how his particular special skills and area of expertise impacted on and related to the other operating systems in his organization.

When developing tactical skills, the organizational leader needed to learn to understand the interrelationship of systems in order to synchronize or orchestrate the operations of their organization.[46]

Understanding systems was also a key task performed in influencing, operating and improving actions. The organizational leader's influencing actions included understanding systems when developing courses of action. Organizational leader operating actions required the leader understand the interrelationship of systems in order to conduct all planning and orders development. Finally, organizational improving actions required the leader to understand the interrelationship of systems in order to focus the development of his organization.[47]

The simulations evaluated were considered successful in this criterion if they met the following measures of success. First, the simulation had to require the user to integrate three or more of the battlefield operating systems in order to achieve success. The potential battlefield operating systems the simulation needed to integrate were those of intelligence, maneuver, fire support, air defense, mobility and survivability, and logistics. The final battlefield operating system, battle command, was not assessed as part of this criterion. Battle command was not assessed because the tasks that battle command addressed were discussed in criterion two and four. Battle command required the user to identify problems, as in criterion two, and required the user to visualize the battlefield and the endstate, which was addressed in criterion four. The second measure of effectiveness for criterion three was that the simulation required the

user to balance organizational resources against the requirements of the operation in order to be successful. Resources were not limited to logistics and included the time and combat power available.

Criteria Four: The simulation taught organizational leaders to identify the solution.

The fourth criterion determined simulation's ability to teach organizational leaders to identify the solution. Developing the ability to formulate a solution was a key task in developing interpersonal, conceptual, technical and tactical organizational skills. In developing interpersonal skills, organizational leaders needed to establish solutions in order to build unit discipline, confidence and motivation. To build conceptual skills, the organizational leader needed identify solutions as part of their complex problem solving and critical thinking skills. In order to develop technical skills, the organizational leaders needed to identify solutions and the second and third order effects of the solutions they enacted. When developing tactical skills, the organizational leader needed to learn to identify solutions that encompassed the individual efforts of their unit and maximize the synchronization or orchestration of the operations of their organization.[48]

Identifying the solution was also a key task performed in influencing, operating and improving actions. The organizational leader's influencing actions included identifying solutions as part of the overall decision making process. Organizational leader operating actions required the leader to identify operational solutions during the creative staff process and the military decision making

process. Finally, organizational improving actions required the leader to identify the solution in the form of a course of action that would build and develop his organization.[49]

The simulations evaluated were considered successful in this criterion if they met the following measures of success. First, the simulation required the user to visualize the critical sequence of activities necessary to achieve the desired end state. Second, the simulation needed to model the second and third order effects of the decisions made as the solution was implemented.

Chapter 4: Analysis of the Simulations

"Many times I bit my nails while searching the enemy line for a place to break through before my own situation collapsed. I experienced an actual sinking feeling when fresh enemy troops were spotted approaching the battle. And on more than one occasion I was extremely thankful that these were just silicon soldiers I was commanding, because a deteriorating situation on many fronts caused me to freeze, leading to a wholesale disaster for my troops. For those who won't enjoy such a feeling, you can always pause the game and take as much time as you want to figure out what to do. But for me, the real fun was refusing to pause the game and finding out that, under pressure, I would have made a truly awful Civil War commander! No other game I have ever played has made that more clear or more visceral." -David Kurtz, in a review of Gettysburg.[50]

This chapter conducted the analysis of the simulations by determining if the simulations met each of the criteria identified in chapter four. The success of the simulation to meet the criteria was established by the ability of each simulation to achieve the measures of success associated with each criterion.

Criteria One: The simulation taught organizational leaders to process information.

Sid Meier's *Gettysburg* did not teach the organizational leader to process information. First, the simulation did not teach the user to filter information. The simulation was excellent, perhaps too excellent, at succinctly providing a great deal of information to the user on the screen at any given point in time. Therefore, the user had only to glance at the displays to determine the situation on the battlefield. This did not teach the user to process and filter a large quantity of information in order to determine which was critical and which could be ignored or delayed for a future point in time. In *Gettysburg*, the map and its

underlying displays showed the location and status of friendly forces and the visible enemy forces. This graphical display showed all of the information available to the user concisely and pictorially. One example of this pictorial display was the unit status summary depicted by the unit's flag waving upright, for battle ready status, versus a drooping unit flag, indicating the unit was severely degraded. The user did not need to review unit information to determine the readiness of his units; a simple glance at the flags on the map enabled him to rapidly determine problem area. This simulation, though the use of this constantly displayed and available information, was actually conducting the filtration of the information for the user. This did not allow the user to learn to filter information. *Gettysburg* failed to meet the first measure of success, teaching the user to filter information.

Second, *Gettysburg* did not require the user to prioritize information. All the necessary information was consistently displayed, and in critical cases was reinforce by a courier report. Courier reports also displayed other critical information, as needed, including enemy sightings or key leader deaths. This did not force the user to prioritize the information, causing *Gettysburg* to fail to meet the second measure of success for criterion one, teaching the user to prioritize information. As a result, *Gettysburg* failed to meet criterion one, the ability to process information, by failing to meet both measures of success.

Steel Panthers III succeeded in achieving criterion one by allowing the user to filter a large amount of available information for critical data then prioritize the information needed for mission success. First, the simulation provided large

amounts of detailed information to the user in a variety of forms, requiring the user to filter the available information and tailor the information actively sought in order to obtain information that applied to the decision at hand. Like *Gettysburg* and most simulations, the battle map displayed the location of friendly and known enemy locations. But in *Steel Panthers*, the only unit status displayed was one the user selected. There was no pictorial summary, such as the waving or drooping unit flag found in *Gettysburg*, to rapidly summarize critical information for the user. The user needed to check unit information and determine which of the available information impacted on a pending decision or action. For example, a user checking on a unit status could find in depth detail about the soldiers, incoming replacements, supplies, and other status information, but the only detail needed to make a decision about withdrawal might have been the amount of sabot round remaining. *Steel Panther III* was successful in the criterion's measure of success to filter the available information.

Second, since so much detail and information was available about the user's organization, the user needed to prioritize the information received. A user checking every piece of available information quickly found he was missing opportunities to take the initiative on the battlefield. For example, a player could spend hours counting the number of riflemen or vehicles in each platoon available to shoot each game turn, but eventually learned to check only the status of the critical weapon system once each turn in order to focus on his operational maneuver and objectives. *Steel Panther's* ability to allow users to

both filter and prioritize information allowed the simulation to successfully meet the first criterion, teaching organizational leaders to process information.

The Operational Art of War Volume II also successfully met the first criterion by allowing the user to filter a large amount of available data for critical data and to prioritize the information needed for mission success. *The Operational Art of War* challenged the user by providing many detailed facts and data about the user's organizations. By conducting battles at the operational level, the simulation required the unit to filter through a large amount of information. Very little of that information was displayed pictorially on the map, which shows only the types of units and the unit location. Additional tabs allowed the user to request and filter a variety of information, including attack and defense strengths, movement allowances, weather, scenario, current situation, reinforcements, news reports, and sustainment status, at the beginning of each game turn in order to maneuver and set objectives for each unit. *The Operational Art of War* made the filtering of the information the focus for the users game turn.

The Operational Art of War also required the user to prioritize the available information. In each turn, the user received the results of the combat for each unit. Since each scenario has more than fifty individual units, the user needed to determine which organizations were the most critical to his operation and focus on the information about those particular units. The user had to prioritize which information about that unit was important at any given moment in order to decide which information required an action or decision on his part. For

example, was it important that there were replacement units entering the theater, or was it more important that a particular corps had sustained over forty percent casualties? The simulation's ability to allow users to actively filter and prioritize information supported *The Operational Art of War's* ability to meet criterion one, teaching the user to process information.

Gary Grisby's *Pacific War* also successfully met criterion one by allowing the user to filter a large amount of available data for critical data and prioritize the information needed for mission success. *Pacific War* had a large amount of information presented to the user though out game play. The user had hundreds of tasks and options. During each turn a player needed to, as a minimum, design and set forces, mission, targeting, operations, transportation and logistics. The detailed data available to the user each game turn included equipment losses, casualty losses, aircraft replacement pools, industry locations and production, enemy intelligence, zones of control, lines of communication and logistical statuses, including supply and movement. The user learned over time which information is critical to his operation, and when that particular information would impact. For example, of all the battle losses the user experienced in a given turn, the most important information to him might have been the loss of a transport ship to an enemy submarine that carried critical supplies to his main effort. The scope of the *Pacific War* simulation was so large that user failure to learn to find the important nuggets of information quickly resulted in large unit losses and an overall loss of the game.

Pacific War also required the user to prioritize information. As the battle was fought, the simulation presented the battle, movement and resupply status of each unit. With so many units represented, this was a large amount of information for the user to process; therefore, the user had to decide which units were critical to his operation and focus on the success and status information dealing only with that key area. *Pacific War* supported the fourth criterion and taught users to process large volumes of information including large amounts of detailed information that the user needed to filter and prioritize in order to achieve success.

Criteria Two: The simulation taught organizational leader to identify the problem to be resolved.

Gettysburg did meet criterion two, teaching the organizational leader identify the problem to be solved. First, the mission statement provided by the simulation did not require the user to complete a mental mission analysis. *Gettysburg* was exceptionally good at giving the user a mission statement and a situation update. In fact, the situation itself was beautifully presented by allowing the user to listen to the commander's conversation in conjunction with a moving map display of friendly and enemy forces. The commander's conversation presented the situation and the mission required. The simulation then followed with a quick identification of the friendly centers of gravity and decision points. It did this by reviewing the key terrain that must be held at the end of the battle, and identifying the organization's best units and most useful artillery. This did

not allow the user to do his own mission analysis, which caused *Gettysburg* to fail to meet the first measure of success.

Second, for most of the scenarios, the simulation did not require the user to determine an endstate. In fact, the endstate in all of the scenarios was virtually the same. The user was required to maneuver forces to either hold or to capture key terrain. This did not differ based on the forces the user played, or the number of forces involved in the battle. For example, the endstate in the scenario Turning Point: Battle for Little Round Top, was the same in the scenario for High Water Mark: Pickett's Charge. Both required the user to hold the high ground if playing the union forces, and to penetrate or flank if playing the confederate forces. *Gettysburg* therefore failed to meet criterion two, teaching leaders to identify the problem, because it did not allow the user to conduct a mission analysis or to determine the endstate.

Steel Panthers III met criterion two, teaching the organizational leader to identify the problem to be solved. First, the mission statement provided by the simulation required the user to complete a mental mission analysis. The simulation did not provide a mission, although it did provide a general scenario in which the user was required to attack or defend against enemy forces. This general concept required the user to mentally assess the situation and determine what the mission for his forces really is. The user had to identify the key terrain, conducting a mental terrain analysis for mobility and counter mobility. The user had to identify the center of gravity of the enemy in the attack in order to succeed, and identify his friendly force center of gravity to keep his units

operational. For example, players of *Steel Panthers* quickly learn to keep their headquarters units either in fortified position or constantly mobile to protect the communication abilities of their forces. The user needed to determine the key decisive points that will allow him to defeat the enemy. The simulation forced the player to conduct this mission analysis early in the battle by quickly defeating players that failed to do so. Players that tried to attack enemy forces simply by proximity without regard to terrain, the enemy order of battle, and the enemy's endstate were quickly outmaneuvered and defeated by the simulation.

Second, *Steel Panthers* required the user to determine and set an endstate for each scenario. The user needed to formulate this endstate in order to achieve success on the scenario's battlefield. The simulation forced the development of an endstate by placing time constraints on the user. A player was given a set number of turns in which to win a scenario. This forced the player at the outset of the scenario to determine where his forces needed to be and what tasks they had to accomplish by the final game turn. A player that failed to do this and simply attacked the enemy forces had the enemy declare victory in the final game turn, no matter how successfully he had seized terrain and defeated enemy forces. *Steel Panthers III* met the second criterion, teaching leaders to identify the problem, by forcing the users to conduct a mission analysis and determine a mission endstate.

The Operational Art of War Volume II met criterion two, teaching organizational leaders to identify the problem to be solved. First, the simulation required the user to complete a mental mission analysis. *The Operational Art of*

War opens with a lengthy scenario briefing, and a general mission statement. The mission is always very broad and usually couched in terms of attack, defend or launch a counterattack. The user had to conduct a mission analysis to determine what actions to take to be successful. The simulation required the user to complete an intelligence preparation of the battlefield in terms of analyzing the enemy forces and the effects of terrain and weather on his forces. Terrain significantly affected unit movements in *The Operational Art of War*, while weather determined his aircraft flying capability and the effects of chemical use. The user also needed to conduct a lengthy review of available assets, as the simulation provided detailed information about the status of each organization, including forces building outside of his battle space. Failure to identify the correct mission early in the process usually left the user surprised by a suddenly losing the war.

The Operational Art of War also required the user to determine his endstate. New users that failed to visualize an endstate were surprised to suddenly find the enemy suing for peace half way through their operation. Scenarios could be influenced by strategic events outside of the theater, which forced the user to determine what his end state should be, or find that suddenly his scenario had ended with no regard to how well he had fought individual battles. For example, a user that did not consider the effects that operations in other theater would have on his mission, might have decided that the scenario's endstate should be capturing the enemy country's. Finding his forces destroyed by nuclear weapons halfway through the scenario when his enemy's allies were

defeated would then surprise this user who had not correctly identified the endstate. *The Operational Art of War* met the second criterion, teaching leaders to identify the problem, by forcing the users to conduct a mission analysis and determine the mission's endstate.

Pacific War also met criterion two, teaching organizational leaders to identify the problem to be solved. The simulation required the user to complete a mission analysis, by requiring the user to conduct an intelligence preparation of the battlefield, review available assets, and identify critical facts and assumptions in order to determine the correct problem to be addressed. One example of this in *Pacific War* was determining a key piece of terrain, what assets were needed to secure it, and why it was part of the problem at hand. The simulation recreated the historical key terrain and the user needed to correctly identify this key terrain in order to focus on complete a mission analysis. The importance of friendly force occupation of the airfield at Rabaul was a great example of mission analysis in *Pacific War*. Many first time players will ignore Rabaul as a piece of key terrain when playing. Experience soon teaches that much of the control of the allied lines of communication hinges on control of the Rabaul airfields. The player in control of Rabaul is the one that controls to a great degree the ability to transport troops and equipment and supply the fight in the Philippines and the East Indies. *Pacific War* was able to achieve the first measure of success for this criterion.

Pacific War also met the second measure of success, the establishment of an endstate. In such a large battle, the user needed to clearly define his

endstate. The user did not have enough resources available to conquer every enemy force or hold every piece of terrain. Therefore, the user had to decide what ground needed to be held at the end of the battle in order to achieve victory. Failure to define an endstate led the user to fail to focus combat power at the correct objectives and resulted in a loss of the war. *Pacific War* was able to support the second criterion, teaching leaders to identify the problem, because it forced the users to conduct a mission analysis and determine the mission's endstate.

Criteria Three: The simulation taught organizational leaders to understand the interrelationships of systems.

Gettysburg was able to establish the third criterion's requirement to teach organizational leaders to understand the interrelationships of systems. *Gettysburg* met the first measure of success by requiring the user to integrate four of the battlefield operating systems in order to achieve success. The simulation was able to reproduce the combined effects of intelligence, maneuver, fire support, and mobility and countermobility. Intelligence systems in *Gettysburg* were not complex systems but were simulated by small numbers of skirmishing soldiers ahead of the main body whose focus was to locate enemy organizations, or by using the mounted commanders to ride ahead, looking for ambushes or hidden enemy forces. The user needed to integrate the products of the intelligence system with maneuver and fire support in order to achieve success in operations. Maneuver was the primary operating system in *Gettysburg*, and was a function of two primary unit actions: formations and facing

movements. With these commands, the unit maneuvers his forces to the fight. Maneuver must be integrated with intelligence to prevent devastating flank attacks. Fire support in *Gettysburg* was limited to two artillery systems, the smooth bore Napoleons for shorter distances and the longer ranged rifled artillery pieces. The user needed to closely integrate fire support with the maneuver of the ground forces in order to be successful, as artillery in this simulation was critical to creating openings in enemy lines. Mobility and survivability were integrated with maneuver by impacting on unit movements and affecting decisions to entrench. Gettysburg supported the first measure of success for criterion three, integrating four battlefield operating systems.

Gettysburg also supported the second measure requiring the user to balance resources against requirements. *Gettysburg* does not support logistics except to degrade the fighting ability of the soldiers as they tire or suffer adverse morale effects, and so was not able to balance the sustainment resources. However, it was able to balance resources against requirements by requiring the commander to correctly resource the fight. Commanders needed to allocate time to unit to physically move, whether for ground units that must walk to battle or artillery pieces that must be moved and unlimbered in order to support the fight. The user must support his main fight by massing combat power at critical points and advantageously placing his reserves. *Gettysburg* met criterion three, teaching leaders to understand systems, by requiring the user to integrate three or more of the battlefield operating systems in order to achieve success, and to

balance the organizational resources against requirements in order to be successful.

Steel Panthers III was able to establish the third criterion's requirement to teach organizational leaders to understand the interrelationships of systems. *Steel Panthers* met the first measure of success by requiring the user to integrate five of the six battlefield operating systems analyzed in order to achieve success. All of the battlefield operating systems were simulated with the exception of air defense. While it was possible in the simulation to destroy enemy aircraft, this was not done by specific fire missions from air defense units. Usually opposing force aircraft destroyed friendly aircraft. Intelligence was simulated by "spotting ability" which was any systems ability to see the enemy; helicopters and infantry had the most advantageous reconnaissance ability. Intelligence in *Steel Panthers* needed to be closely integrated with fire support in order for effective direct and some indirect fires. Logistics and mobility were simulated and closely integrated. This was because the key logistical aspect simulated was transportation, even to the extent of loading combat units on barges. Terrain and obstacles, including entrenchments, mines, dragon teeth and barbed wire, effected transportability. These battlefield operating were integrated with maneuver to achieve battlefield success. Ground units moving under their own power without the benefits of the supporting battlefield operating systems were quickly destroyed, usually causing the user to be defeated. *Steel Panther III* met the first measure of success for criterion three.

Steel Panthers met the second measure of success by requiring the user to balance organizational resources against requirements. Units only had access to a limited number of resources, such as ammunition and transportation, each game turn. The user had to apply those resources to the mission objectives in order to achieve victory. For example, in one scenario the combat force with the armor piercing rounds needed to be conserved for the battle during the final game turn at the enemy headquarters location. *Steel Panthers* met criterion three, teaching leaders to understand systems, by requiring the user to integrate the battlefield operating systems and to balance the organizational resources against requirements in order to be successful.

The Operational Art of War Volume II was able to establish the third criterion's requirement to teach organizational leaders to understand the interrelationships of systems. The simulation met the first measure of success by requiring the user to integrate all of the battlefield operating systems in order to achieve success. *The Operational Art of War*, like *Steel Panthers*, simulated five of the six battlefield operating systems available for analysis, and these five needed to be closely integrated to ensure battlefield success. Intelligence *in The Operational Art of War* was conducted by three types of reconnaissance assets: individual unit observation, internal security, which provides information on the users rear areas, and theater reconnaissance, which includes assets from spies to reconnaissance aircraft. Intelligence had significant effects on all of the other battlefield operating systems by heavily influencing targeting of both combat and rear area operations. Maneuver needed to be closely linked to logistics in this

simulation to achieve success. Unit combat readiness was dependent on supplies and most movements required transportation assets. Logistics and maneuver both needed to be tightly integrated with mobility operations, which included bridging and fording rivers, and occupying fortifications. Fire and air support were also critical to achieve success in maneuver. *The Operational Art of War* met criterion three's first measure of success.

The Operational Art of War also achieved the second measure of success, balancing organizational resources against requirements. This was exemplified by the extensive requirement for logistical resources, but was also supported by the criticality of time and combat power. The user needed to control both logistics supply points and friendly lines of communication to be successful in operations. The user also needed to allow individual units movement and resupply time, in order to conduct effective maneuver operations. The simulation required the unit to focus combat power at specific objectives in order to conduct operations; simply fighting nearby enemy forces resulted in overall mission failure. *The Operational Art of War* supported criterion three, teaching leaders to understand systems, by requiring the user to integrate the battlefield operating systems and to balance the organizational resources against requirements in order to be successful.

Pacific War was able to establish the third criterion's requirement to teach organizational leaders to understand the interrelationships of systems. The simulation met the first measure of success by requiring the user to integrate the battlefield operating systems in order to achieve success. Pacific War did not

however simulate all of the battlefield operating systems; it was limited to fire support, maneuver, and logistics. This was because Pacific War was a strategic wargame, and was focused on resourcing the war, rather than conducting the tactical operations of battle. However, Pacific War excelled at integrating logistics with maneuver on a large scale. Logistic was focused at the strategic level and was concerned with transportation, sustainment, force replenishment and the industrial base. Logistics needed to be integrated with maneuver in order to get combat forces to the fight, protect lines of communication, and obtain more combat forces, personnel and equipment. Fire support was integrated into maneuver usually by air and sea based indirect fire systems. Air support was used to delay, disrupt and destroy enemy forces to achieve ground maneuver success, and sea based fire support was utilized to launch amphibious assaults and maintain sustainment bases. The integration of these battlefield operating systems allowed *Pacific War* to meet the first measure of success.

Pacific War also supported the second measure of success, balancing resources against the operational requirements. The detailed resourcing found in *Pacific War* was critical to the strategic plan. Japanese forces had to achieve success rapidly, as their industrial base is limited, while the U.S. continued to increase its industrial base over time. Port and airfield facilities could be built up and improved to support operations. Japanese forces had experienced pilots in the beginning, but their inability to replace them as the war progresses led to a loss of the war. Forces needed to be built, transported, and sustained to be

effective. Players needed ensure resupply of bases in contention or enemy zones; submarines or any enemy force operating in that zone attacks even routine convoys. *Pacific War* supported criterion three, teaching leaders to understand systems, by requiring the user to integrate the battlefield operating systems and to balance the organizational resources against requirements in order to be successful

Criteria Four: The simulation taught organizational leaders to identify the solution.

Gettysburg was able to establish the fourth criterion's requirement, teaching organizational leaders to identify the solution by requiring the user to visualize the critical sequence of activities to achieve a desired end state, and by modeling the second and third order effects of the decisions made as the user's solution was implemented. *Gettysburg* met the first measure of success by requiring the user to visualize the critical sequence of activities to achieve a desired end state. *Gettysburg* was able to simulate this because it simulated maneuver as a function of time and distance. The forces in *Gettysburg* were all ground based, and were limited in movement by the amount of time and the effort required for soldiers and horses to march over varying types of terrain. This forced the user to develop a plan early in the battle so that forces were positioned in locations that both supported his plan and provided flexibility to react rapidly to unpredicted events. For example, a reserve unit in the vicinity of Culp's Hill would take time to conduct a movement to fill a breach at Little Round Top. This meant that the user needed to determine how the fight at Little Round

Top would affect his operations. He would need to decide if Little Round Top had sufficient forces to repel enemy attacks, that Little Round Top was not critical to his plan, or that he needed to position reserves closer to Little Round Top so that they would be able to reinforce that area. *Gettysburg* was able to achieve the first measure of success for criterion four.

Gettysburg was able to model the second and third order effects of decisions made in the users solution. The simulation showed the consequences of decisions made in battle, and it was possible to trace these actions back to the decision made. For example, a decision made to pursue success might result in a weakening of the line of defense and a flank attack by the enemy. The use of a reserve unit to fill a breach at one end of the friendly line could result in many consequences from success in filling the breach to an exhausted reserve unit arriving too degraded to fight, resulting in a collapse of the friendly flank. These examples demonstrate the second and third order effects of decisions made, forcing the user to think clearly through his plan before operations commence. *Gettysburg* was able to teach organizational leaders to identify the solution by requiring the user to visualize the critical sequence of activities necessary to move the unit to the desired end state, and modeling the second and third order effects of the decisions made as the user's solution was implemented.

Steel Panthers III was able to establish the fourth criterion's requirement to teach organizational leaders to identify the solution. First, *Steel Panthers* required the user to visualize the critical sequence of activities to achieve the desired end state. The aspect of the simulation that made this so critical to the

user was the limitation on the number of game turns allotted to complete the mission. By placing the time limit on the user, the simulation forces the user to invest a lot of thought in planning the activities in each game turn. This mentally forced the user to plan a series of events and objective for each turn, which became a course of action solution to a scenario problem. Failure to plan for each step caused the user to lose the game. *Steel Panthers* was able to support the first measure of effectiveness for criterion four.

Second, *Steel Panthers* was adept at modeling the second and third order effects of decisions made by the user each game turn. The user was able to clearly see how his actions in game turn two affected the situation in game turn seven. For example, when playing the German forces in the scenario Our River Delaying Action, a decision in game turn one or two on where to conduct the river crossing significantly affected whether the user could defeat the US forces holding the opposing side in game turn seven. The second and third order effects of the river crossing were clearly modeled. *Steel Panthers III* was able to teach organizational leaders to identify the solution by requiring the user to visualize the critical sequence of activities necessary to move the unit to the desired end state, and modeling the second and third order effects of the decisions made as the user's solution was implemented.

The Operational Art of War established the fourth criterion's requirement to teach organizational leaders to identify the solution. *The Operational Art* of War required the user to visualize the critical sequence of activities to achieve victory in the operation. The game was able to simulate this by reproducing

many factors that could effect the outcome of the battle. This required to user to determine about how a large operation with so many moving pieces and effects could be conducted. New users with little experience who simply attacked enemy forces quickly lost the operation in that scenario. Once the user identified the end state as in criterion two, he had to plan the events that would allow him to achieve that endstate. The simulation allowed this solution set to be complex. For example, a user might decide that the critical events needed to achieve his end state included establishing and maintaining air superiority, repositioning supplies forward, then penetrating the enemy front line first to the east with a deception demonstration to the west and center of the enemy line. Solutions needed to be flexible to allow for unforeseen circumstances like enemy artillery destruction of a main supply route. *The Operational Art of War* forced the user to visualize the events to achieve an endstate, meeting the first measure of success for criterion four.

The simulation also modeled the second and third order effects of the decisions made by the user. For example, a decision to penetrate the enemy forward line without providing units to secure the lines of communication not only resulted in the forward units being isolated, but also allowed for an enemy unit counter attack along that same route. The simulation could model second and third order effects at a strategic level as well as at the tactical level. For example, the user's decision to attack across an international border could trigger a second theater war that decreases the users available replacements. *The Operational Art of War* was meet criterion four by requiring the user to

visualize the critical sequence of activities necessary to move the unit to the desired end state, and modeling the second and third order effects of the decisions made as the user's solution was implemented.

Pacific War met the fourth criterion requirement to teach organizational leaders to identify the solution. *Pacific War* required the user to visualize the critical sequence of activities to achieve victory in the operation. It is impossible to play this game and win without visualizing completely the sequence of activities to achieve the desired endstate. The key concept of *Pacific War* is to maneuver and resource friendly forces while denying the same to the enemy. Bases and force basing are critical for success, one of the critical parameters of the game that make it a success at the strategic level. Basing concepts forced the user to consider areas of influence for each of the services, and how each affects and interacts with the various enemy forces. One of the most powerful designs of the game is the basing and location of air forces because of the influence of their zones of control. Basing issues forced the user to look at the entire campaign from a strategic level, and as part of intent, break the problem into its component parts. The user had to decide which bases were critical to their plan of operation, which bases had more strategic importance and strategic relevance, which were critical to friendly and enemy lines of communication, and where the resources necessary for success were located. Wasting resources and time on a base that was not critical caused the user to lose the game.

Pacific War was also adept at developing the thought process behind predicting second and third order effects. For example, failure to secure bases

with resources and supply points quickly resulted in the decimation of maneuver units as they quickly ran out of supplies, personnel and equipment, and resulted in the loss of that piece of terrain. If the terrain lost was critical, it was possible to lose the entire war. *Pacific War* met criterion four by requiring the user to visualize the critical sequence of activities necessary to move the unit to the desired end state, and modeling the second and third order effects of the decisions made as the user's solution was implemented.

Chapter 5: Conclusion and Recommendations

Technology will also allow a foe to wage war on the cheap. For example, technology is supposed to give our forces an edge in training; but consider that the dramatic advances in computerized teaching techniques also will make sophisticated instruction available at low cost to the asses in less-developed areas. This instruction will not just address ways to learn to use or maintain particular weapon systems, but also methods to master actual tactical combat techniques. Sound far-fetched? In the April 1997 issue of Wired magazine is a story that explains how a $49 computer simulation program is being used to teach young Marines just such skills. –Colonel Charles J. Dunlap, Jr, in 21st Century Land Warfare: Four Dangerous Myths[51]

Conclusion.

This study suggests, from the ability of the small sample analyzed to meet the criteria, that it may be possible to the Army to use commercial simulations to help develop organizational leader skills and actions at a reduced cost.

The simulations analyzed in this monograph were, with two exceptions, able to meet the criteria that evaluated the ability of commercial simulations to develop organizational leadership. The two exceptions found were in the simulation *Gettysburg's* inability to teach organizational leaders to process information and to identify the problem to be resolved. Despite these two exceptions, the author to concluded that organizational leaders, including commanders, planners, and staffs, could derive the benefits of improved organizational leadership interpersonal, conceptual, technical and tactical skills, and organizational influencing, operating, and improving actions, as defined in FM 22-100, *Army Leadership*. The simulations can, as J.C. Fernan stated in his thesis on the training value of commercial models, support organizational leadership training by allowing leaders to examine possibilities.

> Players can recreate actual historical battles, create and fight their own designed battles, and examine the underlying principles of warfare with models. Officers can use models to form the basis of a professional development program or as a training tool for their soldiers. Finally, doctrinal and tactical issues such as synchronization of combat forces, command and control and resupply can be examined to varying degrees with models.[52]

Organizational leaders can do this by developing their abilities to process large amounts of information, identify problems, understand systems and formulate solutions.

The benefits of using commercial simulations to accomplish these tasks could result in large savings for the US Army. The use of commercial simulations could allow the Army to conserve critical research and development dollars, because the commercial simulations are already in existence and do not need to be developed, and cost less than fifty dollars per game. Units could also reduce operational training costs by training for leader proficiency in these tasks before conducting large unit field exercises.

Recommendations

The success of the four simulations analyzed invites the opportunity for further study. The author suggests two possibilities for further study.

The first possible action suggests that the Army should conduct further and more extensive studies about the use of commercial simulations for organizational leadership training. Army resources would allow more simulations to be examined at a variety of Army institutions. The author suggest using commercial simulations in small groups at Army development schools such as

officer advance courses and the Command and General Staff College. A second study could be conducted in units at the brigade, division, or corps level to determine the effects of group interactions when using a simulation.

The second possible action would be to support individual analysis of additional simulations with different leadership criteria. This monograph could only analyze four criterion and four simulations in the time available. Further analysis of additional games could determine if the Army should pursue a policy of securing commercial simulations for the use of individual leadership development.

Endnotes

[1] Robert Chicchi, Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm.
[2] Robert Chicchi, Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm "Prior to WWI, one of the greatest advocates of wargames was Alfred von Schlieffen, Chief of the German General Staff from 1892 until 1906. His staff used wargaming to develop the "Schlieffen Plans" for the invasion of Belguim and France...In August of 1941 the War College in Tokyo conducted wargames that included naval operations involving a surprise attack on Pearl Harbor."
[3] J.C. Fernan, "Gettysburg: An Analysis of the Training Value of Commercial Models" (Master's Thesis, Air Force Institute of Technology, 1992), 1.
[4] One example of this is the Army's School of Advanced Military Studies advanced military studies program at Fort Leavenworth. They use Steel Panthers and Pacific War in their program.
[5] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 5-14.
[6] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 1-2 to 1-3.
[7] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 1-10.
[8] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 1-11.
[9] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 1-11.
[10] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-3 to 6-10.
[11] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-12 to 6-25.
[12] J.C. Fernan, "Gettysburg: An Analysis of the Training Value of Commercial Models" (Master's Thesis, Air Force Institute of Technology, 1992), 5.
[13] Jane's Homepage, About Jane's, http://www.janes.com/company/about/about_home.html. The youngest son of a vicar, John Frederick Thomas Jane turned a passion for naval ships and naval warfare into a lucrative business. Jane compiled his detailed sketches and notes on naval ships and in 1898 published the first edition of Jane's All the World's Fighting Ships. This book started a series of publications and an extensive business. Today, the Jane's series of books, articles, magazines and reports is considered the authoritative guide and reference source on military equipment and many other defense issues.
[14] David Kurtz, Games Domain Review, *Gary Grigsby's Pacific War*, http://www.gamesdomain.com/gdreview/zones/reviews/pc/june/pacwar.html.
[15] Robert Chicchi, Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm. In later years, the German variation of this game was known as Kriegsspiel. "Colonel von Verdy du Vernios of the German Army developed a free-play form of Kriegsspiel which used a minimum of rules and calculations but depended heavily on the judgement of umpires" in 1876.
[16] Robert Chicchi, Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm. "The first American authority on wargaming was U.S. Army Major W.R. Livermore, who learned about wargaming from a civil engineer of the Barvarian Army." Influenced by Livermore, Army Lieutenant A. L. Totten "devised a set of games in 1879 called Strategos, that were suitable for small American garrisons." The Army did not endorse these game due to their complexity. This writer was unable to establish if this Army game called Stategos was the basis for the popular Parker Brother's board game Stratego.
[17] Robert Chicchi, Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm. "Through WWI the U.S. Army used the free Kriegsspiel style of wargaming extensively, utilizing maps, contour maps and

overlays to depict different strategic scenarios. During WWII, mathematicians began to study weapon performance. By analyzing numerous identical situations, they were able to provide a statistical basis for weapon usage and tactics."

[18] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 147.

[19] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 147.

[20] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 147-153.

[21] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 172-173. In 1977 that was Radio Shack's TRS80. Radio Shack was able produce and sell this computer quickly; as a result more people owned Radio Shack computers than any other computer at this time. These computers, by today's standards, were little more than glorified black and white word processors, consisting of a keyboard, television monitor and a tape recorder with only 16K to 48K of memory.

[22] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 174.

[23] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 179.

[24] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 178-183.

[25] Jay Heizer and Barry Render, *Production and Operations Management-Strategic and Tactical Decisions*, 4th ed., (New Jersey: Prentice Hall, 1996), 54-55.

[26] Principia Cybernetica Web, *Systems Analysis*, http://pespmc1.vub.ac.be/ASC/SYSTEM_ANALY.html Some collegiate instructional texts describe a model as a system that stands for or represents another typically more comprehensive system. A model consists of a set of objects, described in terms of variables and relations defined on these and either (a) embodies a theory of that portion of reality which it claims to represent or (b) corresponds to a portion of reality by virtue of an explicit homomorphism or isomorphism between the model's parameters and given data.

[27] Jay Heizer and Barry Render, *Production and Operations Management-Strategic and Tactical Decisions*, 4th ed., (New Jersey: Prentice Hall, 1996), 55. There are many different categories of models, depending on what subject area you are dealing with. Usually, models are divided into two categories: physical models and mathematical models. Physical models are quite literally a physical representation of a system, usually on a smaller scale such as an aircraft in a wind tunnel. Mathematical models use numerical values and complex equations to define the systems. Knowing the type of model and the structure on which it is based allows the user to understand the limitations inherent in software programs. The advantages of using a model are that they are less expensive and disruptive than experimenting with the real-world system; they allow managers to ask "what if" types of questions; they are built for management problems and encourage management input; they force a consistent and systematic approach to the analysis of problems; they require managers to be specific about constraints and goals relating to a problem; and they help reduce the time needed in decision making. The disadvantages of using a model are that they are only as accurate as their input data, and they provide very specific information that is subject to interpretation.

Users of models must know when a model is appropriate, what its assumptions and limitations are, what purpose a model might serve in studying a particular problem, how to use the model and produce results, and how to interpret the results of the model.

Computer battlefield software also contains elements of decision support system (DSS) models. These are extensions of management information systems that aid managers in modeling and decision making. Rather than simply providing information, a DSS allows a manger to perform "what-if" analysis given certain operating parameters.

[28] Principia Cybernetica Web, *Systems Analysis*, http://pespmc1.vub.ac.be/ASC/SYSTEM_ANALY.html The commercially available software used in this monograph resemble a behavior model, in which the relations are transformations,

equations or operating rules and the representation is based on the assurance that the behavior of the model corresponds to the behavior of the system modeled. This is established either by identifying the model's parameters and equations, or showing that the homomorph is not violated.
[29] Jay Heizer and Barry Render, *Production and Operations Management-Strategic and Tactical Decisions*, 4th ed., (New Jersey: Prentice Hall, 1996), 618. The idea behind a simulation is to imitate a real-world situation mathematically, study its properties and operating characteristics, and finally draw conclusions and make action decisions based on the results of the simulation.
[30] James R. Wilson, Paul A. Fishwick, and Keebom Kang. The Winter Simulation Conference: The Premier Forum on Simulation Practice and Theory, http://wintersim.org/article.htm. Other types of simulations include:

- **Modeling Methodology:** Animation; artificial intelligence; concepts and techniques for general systems modeling; discrete-event and combined discrete-continuous simulation; high level architecture; knowledge-based simulation; model specification and development; object-oriented simulation; parallel and distributed simulation; support environments; software engineering; verification, validation, and testing; web-based simulation.
- **Analysis Methodology:** Efficiency improvement (variance reduction) techniques; experimental design; financial engineering; metamodels; modeling, fitting, and generating stochastic input processes; optimization; output analysis; quasi–Monte Carlo methods; random number generation; ranking and selection procedures; rare-event simulation; start-up techniques; sensitivity analysis; statistical graphics.
- **Manufacturing Applications:** Cellular systems; computer integrated manufacturing; facilities planning; flexible systems; materials handling; production and inventory control; online control; robotics; scheduling; warehousing and distribution; virtual manufacturing.
- **Logistics, Transportation, and Distribution Applications:** Airport, airline, and air cargo operations; distribution systems; freight systems; intelligent transportation systems; intermodal facilities; logistics engineering; pedestrian movement; port operations and shipping; rail systems; rapid transit systems; street and highway traffic; supply chain management.
- **General Applications:** Agriculture; business process simulation; call center modeling; computer and communication systems; construction engineering; energy systems; environmental engineering; financial models; governmental applications (e.g., policy planning and regulation); healthcare; project management; service systems; simulation education; simulation in education.

Military Applications involve battlefield simulation, evaluation of strategies, distributed simulation, graphical techniques, and high level architecture.
[31] Jay Heizer and Barry Render, *Production and Operations Management-Strategic and Tactical Decisions*, 4th ed., (New Jersey: Prentice Hall, 1996), 618. Simulations are used systemically to define the problem, introduce the important variables associated with the problem, construct a numerical model, set up possible courses of action for testing, run the experiment, consider the results (possible modify the model or change data inputs), and decide what course of action to take.

There are many advantages to using simulations. They are relatively straightforward and fairly flexible. They can be used to analyze large and complex real-world situations. Simulations can analyze situations not possible in the real world. Simulations can compress time, allowing the effects of decisions over months or years to be obtained in minutes. Users can ask "what if" types of questions by using simulation, and see the second and third order effects of decisions. Simulations do not interfere with their corresponding real world system, minimizing disruptions and allowing for experimentation. Finally, simulations promote the study of the interactive effects of individual components and variables. Simulations also have limitations and disadvantages. Simulations can be very expensive. They are not designed to generate optimal solutions to problems, and are limited inputted conditions and constraints for the solutions examined. Finally, the uniqueness of each simulation usually makes it impossible or at least difficult to transfer its solutions and to other problems.

[32] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 163-167. It treats "accounts of historical events in a systemic and highly organized fashion", and "attempts to duplicate a past event, including duplicating the key elements of that past event that the original participants had to deal with." This is due to the nature of the evolution of the wargame itself from its early map and math days to the computer days. Initially, computerized wargames were termed simulations instead of wargames, because many of the players of the games were not so much game players as they were history buffs. While many history buffs were "content to read a book on battles and campaigns, watch a good film on war, or wander through battlefields", a wargamer preferred to "measure and analyze things."

[33] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 163-168. A wargamer finds these games powerful because they are "non-linear." Linear narratives "such as books and films, go from point to point while non linear-simulations can jump around and still keep in context enabling the user to see the relationship in various events that are not readily apparent in a chronological reading." One writer describes wargames as "an analytic history", and lists his ideas of the key elements that make such games a success. First, each game needs the basic components, which describe the essential part of each history: the map, order of battle, combat results, terrain effects, and the sequence of action. Second, each must have a time line with a narrative or descriptive history that give a description of what happened and who did what to whom. The third element is the presentation of the game, which includes how the graphics are displayed and what descriptions are given. Finally, to be a success, the game must demonstrate the selectivity and conciseness of its designer in establishing what elements of military history are covered, where the boundaries are, what limitations the game has, and to what level of the game will go. These wargames are not limited by past reality. The wargame can reconstruct the details of these elements listed above to allow the user to look at an alternate unfolding of events based on different decisions made. Many games with historical or modern battles allow a user to design a unique scenario based on their particular interests. For instance, with certain games, the user can create a scenario where a World War II battle is fought using Desert Storm equipment, or plan a confrontation between modern U.S. forces and Russian forces in modern day Chechnya.

[34] James F. Dunnigan, *The Complete Wargames Handbook* (New York: William Morrow, 1992), 164. This is why so many wargamers don't game at all, but simply study and manipulate the game by themselves.

[35] The comlete list of the twenty original games reviewed included in addition to the four games selected for evaluation: Talonsoft's *Antietam*, Talonsoft's *Napolean in Russia*, HPS' *Panzer Campaigns: Smolensk '41*, Arsenal Publishing company's *TacOps*, Red Storm Entertainment's *Force XXI*, Talonsoft's *West Front*, Strategic Simulation's *Panzer General II*, Strategic Simulation's *Allied General*, Hasbro's *Axis and Allies*, Decision Game's *War in Europe*, Strategic Simulation's *Clash of Steel*, Microsoft's *Age of Empires*, Talonsoft's *Battleground 2: Gettysburg*, Strategic Simulation's *Steel Panthers*, Strategic Simulations *Steel Panther II*, Talonsoft's *The Operational Art of War Volume I*

[36] In the final step, the author determined how many of the simulations could be evaluated based on the time available in which to conduct research. The time available to conduct research was divided by the amount of time required to learn to operate the simulation, the time to play several scenarios of the game, and the time to evaluate the simulation. To maximize the use of the available time, the author gave priority to simulations that met the above criterion with which she already had experience. Elimination based on the above criterion left seven games possible for the author to evaluate, still too many to address within the scope of this monograph in the time allotted. The author determined that, based on the required length of the monograph and the time available to conduct the research, four games would be analyzed.

[37] Other options for historical wargames: Talonsoft's *Antietam* and *Napoleon in Russia*, HPS Simulation's *Panzer Campaigns: Smolensk '41*
Other options for tactical wargames: Arsenal Publishing company's *TacOps*, Red Storm *Entertainment's Force XXI*, Talonsoft's *West Front*

Other options for operational wargames: Strategic Simulation's *Panzer General II* and *Allied General*, Hasbro's *Axis and Allies*
Other options for strategic level games: Decision Game's *War in Europe*, Strategic Simulation's *Clash of Steel*

[38] Not that the writer of this monograph needs to significantly increase the level of difficulty, as she is not yet expert enough to win decisively in the Peach Orchard.

[39] Unless of course this author is playing German Forces in Stalingrad., where results are very similar to both history and the movie of the same name.

[40] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 1.

[41] Headquarters Department of the Army, Field Manual 101-*5 Staff Organizations and Operations*, (Washington, DC: HQDA, May 1997) 4-1 to 4-32.

[42] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-3 to 6-10.

[43] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-12-6-32.

[44] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-3 to 6-10.

[45] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-12-6-32.

[46] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-3 to 6-10.

[47] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-12-6-32.

[48] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-3 to 6-10.

[49] Headquarters Department of the Army, Field Manual 22-100 *Army Leadership*, (Washington, DC: HQDA, April 1999) 6-12-6-32.

[50] David Kurtz, Games Domain Review, *Sid Meier's Gettysburg*, http://www.gamesdomain.com/gdreview/zones/reviews/pc/dec97/smg.html

[51] Charles J. Dunlap, Jr., "21st Century Land Warfare: Four Dangerous Myths" *Parameters*, (Autumn 1997).

[52] J.C. Fernan, "Gettysburg: An Analysis of the Training Value of Commercial Models" (Master's Thesis, Air Force Institute of Technology, 1992), 3.

Bibliography

Books

Boocock, Sarane S. *Simulation Games in Learning*. London: Sage Publications, 1968.

Brewer, Garry D. and Martin Shubik. *The War Game.* Cambridge, MA: Harvard University Press, 1979.

Freeman, Jon. *The Complete Book of Wargames.* New York, NY: Simon and Schuster, 1980.

Grant, Charles. *The War Game*. New York, NY: St. Martin's Press, 1972.

Heizer, Jay and Barry Render. *Production and Operations Management*. New Jersey: Prentice Hall, 1996.

Janis, Irving L. and Leon Mann. *Decision Making.* New York, NY: The Free Press, 1977.

Marvin, Philip. *Developing Decisions for Action*. Homewood, IL: Dow Jones-Irwin, Inc., 1971.

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

Plous, Scott. *The Psychology of Judgment and Decision Making*. Philidelphia, PA: Temple University Press, 1993.

Russo, J. Edward and Paul J. H. Schoemaker. *Decision Traps*. New York, NY: Simon and Schuster, 1989.

Thiagarajan, Sivasaiam and Harold D. Stolovitch. *Instructional Simulation Games*. Englewood Cliffs, NJ: 1978.

Wade, Norman M. *The Battle Staff SMARTbook.* Lakeland: The Lighting Press, 1999.

Articles

Robel, Michael K. "Three- or Four- Company Battalions?" *Armor* (1999): 40-42.

Dunlap, Chales J. "21st Century Land Warfare: Four Dangerous Myths, *Parameters* (Autumn 1997).

Government Documents

Field Manual 100-5 Operations. Headquarters, Department of the Army, Washington DC, June 1993.

Field Manual 100-5 Operations. Headquarters, Department of the Army, Washington DC, June 1993.

Field Manual 101-5 Staff Organization and Operations. Headquarters, Department of the Army, Washington DC, May 1997.

Field Manual 22-100 Army Leadership. Headquarters, Department of the Army, Washington DC, August 1999.

Research Publications

Bohman, William E. "Staffsim, An Interactive Simulation for Rapid, Real Time Course of Action Analysis by US Army Brigade Staffs." Thesis, Naval Postgraduate School, 1999.

Brecke, Fritz H. "Implementation of Instructional Strategies for Decision Making Training." Technical Paper, Air Force Materiel Command, 1996.

Davis, Paul K. "Generalizing Concepts and Methods of Verification, Validation, and Accreditation for Military Simulations." RAND Research Study for Under Secretary of Defense for Acquisition, 1992.

Ettedgui, Emile., David Oaks, and John Bondanella. "The Use of Microworld Simulations to Train Theater-Level CSS Staffs." RAND Research Briefing for United States Army, 1999.

Farr, John V., Paul D. West, and John Melendez. "Summary Report for USMA Plowshares Initiative." Technical Report, US Military Academy at West Point, 1995.

Fernan, J.C. "Gettysburg: An Analysis of the Training Value of Commercial Models." Master's Thesis, Air Force Institute of Technology, 1992.

Heiden, Charles G. "SIMWAR 2010: The Need for Simulations in the War Gaming and Rehearsal Process." Monograph, School of Advanced Military Studies, US Army Command and General Staff College, 1996.

Levine, Lawrence A. "How Can Maneuver Brigades Train and Educate Excellence in the Execution of Twenty-First Century Battle Command at Home Station?" Monograph, School of Advanced Military Studies, US Army Command and General Staff College, 1998.

Lucas, Thomas W., Steven C. Bankes, and Patrick Vye. "Improving the Analytic Contribution of Advanced Warfighting Experiments." RAND Briefing, for US Army Training and Doctrine Command Analysis Center, 1998.

Olmstead, Joseph A. and B. Leon Elder. "The Use of Management Games for Developing Army Officers in Administrative and Staff Jobs." Technical Report, Defense Technical Information Center, Defense Logistics Agency, 1987.

Quensel, Susan L. and William Myers. "Development of a Refined Staff Group Trainer." Research Report for US Army Research Institute for the Behavioral and Social Sciences, 1999.

RAND Corporation. "Bigger and Better Campaign Models: Will They Improve Decision Making?" RAND Research Brief, RAND's Project Air Force, 1996.

Sterling, Bruce S. and Kathleen A. Quinkert. "Review of Battle Staff Training Research at Brigade and Battalion Level." Research Report for US Army Institute for the Behavioral and Social Sciences, 1998.

White, Scott A. "Constructive Simulations-Readiness Enhancer or Training Distracter?" Thesis, Naval Postgraduate School, 1998.

Internet Documents

Fishwick, Paul. A. The Computer Simulation, http://www.cise.ufl.edu/~fishwick/introsim/nodel.htm.

Geryk, Bruce. *The Operational Art of War*, Games Domain Review, http://www.gamesdomain.com/gdreview/zones/reviews/pc/jul99/toaw2html

Kurtz, David. *Sid Meier's Gettysburg*, Games Domain Review, http://www.gamesdomain.com/gdreview/zones/reciews/pc/dec97/smg.html

Kurtz, David. *Gary Grisby's Pacific War*, Games Domain Review,

http://www.gamesdomain.com/gdreview/zones.reviews/pc/june/pacwar.html

Kurtz, David. *Steel Panthers III*, Games Domain Review, http://www.gamesdomain.com/gdreview/zone/reviews/pc/jan98/sp3.html

Jane's Homepage, About Jane's, http://www.janes.com.

Laskey, Kathryn B. "Bayesian Decision Theory and Machine Learning." Lecture, Department of Systems Engineering and Krasnow Institute, George Mason University, November 21, 1995, http://ite.gmu.edu/`klaskey/machine/tsld001.htm.

MSN Encarta. *Decision Theory*, http://encarta.msn.com/index/conciseindex/5F/05FDD000.htm.

Operations Research Group, The History of Wargaming, http://carlisle-www.army.mil/usacsl/divisions/std/branches/org/histwarg.htm

Principia Cybernetica Web. *Decision Theory*, http://pespmc1.vub.ac.be/ASC/DECISI_THEOR.html.

Principia Cybernetica Web. *Systems Analysis*, http://pespmc1.vub.ac.be/ASC/SYSTEM_ANALY.html.

Team Trackless, TACOPS, http://www.strategypage.com/tt.htm.

Wilson, James R., Paul A. Fishwick, and Keebom Kang. The Winter Simulation Conference: The Premier Forum on Simulation Practice and Theory, http://wintersim.org/article.htm.