THE APPLICATION OF OFF-THE-SHELF MILITARY SIMULATIONS
TO TRAIN DECISION MAKING AND TEACH TACTICS

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General Studies

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other government agency. (References to this study should include the foregoing statement.)

ABSTRACT

THE APPLICATION OF OFF THE SHELF MILITARY SIMULATIONS TO TRAIN DECISION MAKING AND TEACH TACTICS, by Major Jeffrey M. Shoemaker, 60 pages.

The purpose of this thesis is to identify and examine potential applications of off the shelf computer simulations in order to train decision making and to teach tactics at the battalion level and below. This study is intended to be used by leaders at all levels from fire team through the joint task force commander in order to expand their knowledge base of potential training tools for tactics and decision making.

The United States Army has developed very few training tools for the commander to conduct simulations training using the unit's organic resources and focused at the battalion task force level and below. The rapid development of computers and computer simulations provides the commander with a low cost, high yield, training tool to augment and supplement a robust field-training program.

This thesis shows the potential of four commercial simulations for tactics instruction and decision-making development. These simulations provide the commander the ability to conduct simulations training with his organic resources. Simulations training can allow a commander to conduct training on topics and military actions that he cannot support with live training.

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LIST OF ACRONYMS

AAR   After Action Review

AR   Army Regulation

BCTP   Battle Command Training Program

BOS   Battlefield Operating System

BSC   Battle Simulation Center

CCC   Captain's Career Course

CAS3   Combined Arms Staff Services School

CGSOC   Command and General Staff Officer College

CPX   Command Post Exercise

CSS   Combat Service Support

DA   Decisive Action

DIS   Distributed Interactive Simulation

DMI   Department of Military Science

DSAS   Dismounted Simulation and Acquisition System

DOD   Department of Defense

FAMSIM   Family of Army Simulations

FM   Field Manual

FORSCOM   Forces Command

ICT   Institute of Creative Technologies

IGS   Integrated Gaming System

LAN   Local Area Network

MAJ	Major
MMAS	Master of Military Arts and Sciences
MOUT	Military Operations in Urban Terrain
NSC	National Simulation Center
OES	Officer Education System
PC	Personal Computer
SAMS	School of Advanced Military Studies
SOP	Standard Operating Procedure
STRICOM	Simulation, Training and Instrumentation Command
STX	Situation Training Exercise
TEWT	Tactical Exercise Without Troops
TOAW	The Operational Art of War
TRADOC	Training and Doctrine Command
TTP	Tactics, Techniques, and Procedures
UCOFT	Unit Conduct of Fire Trainer
US	United States
USMA	United States Military Academy
USMC	United States Marine Corps

CHAPTER 1

INTRODUCTION

Develop trust soldier-to-soldier, leader to led, unit-to-unit in the Army and grow the warfighting confidence of the force. Train for decisive warfighting. *Train soldiers now, and grow leaders for the next conflict Ensure that our soldiers are physically and mentally prepared to dominate the next battlefield--no soldier goes into harm's way untrained. Our soldiers must be comfortable and confident in the elements-- fieldcraft, fieldcraft, fieldcraft.*

General Eric Shinseki

There are no "low-speed" units in the United States Army. The downsizing of the United States Army and the expansion of commitments worldwide require all units in the United States Army to make the most of every training opportunity. General Shinseki provides the quote above as the introduction to FM 7-0, *Training the Force*. FM 7-0 is the Army's capstone training manual and is applicable to all units, at all levels, and in all components. General Shinseki's intent is to underscore the importance of training the soldiers and leaders of the U.S. Army to fight and win our nation's wars. The operational tempo and the missions that all units are expected to conduct have created a training plan that is complex, demanding and filled to capacity with events. Leaders at all levels have additional training events that they desire to conduct; however, there is extremely limited time available on the training schedule and very few uncommitted training resources. Simulations and simulations training can assist the commander in accomplishing his unit training objectives in a resource-constrained environment. Off-the-shelf commercial simulations are low-cost, high-yield tools for the commander to utilize for simulations training at the battalion level and below.

These events would be value-added training, but without the time and resources to conduct these events, they remain only good ideas. Some of these training events are command post exercises, tactical exercises without troops (TEWTs), and tactical decision-making exercises. These events can be time-intensive and require the support of resources and personnel external to a unit. The required planning, the external resources and the additional time make command post exercises and TEWTs difficult to use as opportunity training. The tactical decision-making exercise is a valuable tool for the commander with limited time and resources.

This thesis will describe a common event in most combat arms units in the United States Army. The battalion has just returned to garrison from a training event in a field environment. All companies are conducting accountability and turning in weapons and equipment. The battalion policy is to not release the soldiers of the battalion until all companies have completed these actions. The Headquarters Company is roughly three times the size of a maneuver company and usually takes much longer to conduct these activities. The maneuver company commander now finds himself with some unanticipated training time as he and his unit complete their recovery operations and await the much-anticipated release of the battalion.

What should this commander do? One obvious answer is to conduct opportunity training. The commander has a wealth of topics to select for this training, such as maintenance, marksmanship, communications, and others. What if he wants to focus on tactics or decision making? How does he do that? What vehicle, instrument or simulation can he utilize to accomplish this focus?

Research Question

The thesis research question is: How can the commander conduct simulation training with his organic resources in order to teach tactics and decision making to his junior leaders? The subordinate questions are: What resources does the U.S. Army provide to conduct simulations training at the battalion level and below? Are there commercial simulations available to support this type and level of training? Do these commercial simulations accomplish the desired training end state without compromising fundamental principles of tactics?

What are Simulations?

The official Department of Defense definition of a simulation is a model that represents activities and interactions over time. There are three types of models: mathematical, physical and procedural. A mathematical model is a representation comprised of procedures (algorithms) and mathematical equations. A physical model is simply a physical representation of an object as it relates to other models in the form of simulators. A procedural model is an expression of dynamic relationships of a situation expressed by mathematical and logical processes. These procedural models are commonly referred to as simulations. Procedural models are the models that we are most familiar with in the military (A733 2002, 1-2).

Wargaming simulations are the most common type of simulation used in the military. Wargaming, as defined by Department of Defense Joint Publication 1-02, DOD Dictionary of Military and Associated Terms, is a simulation of a military operation that involves two or more opposing forces, uses rules, data, and procedures to depict an actual or assumed real-life situation. Wargaming simulations allow the military leader to

develop and conduct the tactics, techniques and procedures required to conduct combat actions in an actual deployment, crisis, conflict or war.

The Army uses simulations to assist in the education and training of leaders and soldiers at all levels. This training is conducted primarily in classrooms, seminar settings, and training exercises. These simulations are used to assist in the teaching of military concepts and allow students to gain insights and understanding in the use of various tactics, techniques and procedures.

The two types of education and training simulations are skill development and exercise drivers. Skill development simulations can be used to assist in training individuals and crewmembers skills on specific vehicles and equipment. An example of a skill development simulation is the unit conduct of fire trainer (UCOFT.) Mechanized and armored units use the UCOFT to develop gunnery skills and crew drills on the M2 Bradley and M1 Abrams vehicles prior to conducting live gunnery training at a range complex.

These simulations can also assist in the training of staff and procedural skills in a structured command and control environment. Exercise driver simulations assist in the training of field organizations and their respective staffs. Exercise driver simulations support the execution of command post exercises (CPX). Examples of exercise driver simulations include JANUS and BBS (A733 2002, 9-10).

<div align="center">Significance of the Study</div>

The international military community has long recognized the benefits of simulations. Thousands of years prior to the invention of computers, military leaders and kings engaged in games of chess. Prior to the invention and application of gunpowder,

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chess and other games like it were effective simulations of warfare and also served as vehicles for education and entertainment. As any amateur historian might guess, the Prussians are responsible for the early developments in simulation and gaming (Dunnigan 1992, 146).

History of Wargames and Simulations

In the seventeenth and eighteenth centuries, the Prussians improved on the game of chess. These simulations were referred to as "Kriegsspiel" or "wargames" as it is translated in English. These simulations included playing pieces that represented or simulated specific military units and incorporated the simulation of terrain on the playing board. These simulations also included a rulebook and provided for the use of reinforcements and logistics (Lee 1990, 43).

The nineteenth century saw the improvement of these games into simulations as they were based on the careful study of military operations. The intent was to model the maneuvers as accurately and realistically as possible. Additional improvements were the replacement of the game board with a sand table and later replacing the sand table with a large-scale map. These simulations became a fixture in German military education and in the planning and testing of military operations. German military successes in the nineteenth century can be attributed in some small degree to the use of these simulations to develop and teach tactics and decision making (Lee 1990, 43).

The Germans' use of simulations as an educational technique and planning resource continued through World War I. The German reliance on simulations would increase in the aftermath of World War I. The limitations of the Treaty of Versailles prevented the Germans from possessing and training with the world's latest technological

innovations, such as tanks and aircraft. The Germans would use simulations to offset the inability of Germany's military forces to conduct live realistic training with the actual equipment and weapons systems.

The American experience with simulations began with an adaptation of the German Kriegsspiel. In 1879, MAJ W.R. Livermore published the "American Kriegsspiel." The features of this simulation included tactical and operational maneuver on a map with ten foot contours and drawn to a scale of twelve inches to the mile. The American Kriegsspiel included a provision for replicating the fog of war by providing less than perfect intelligence on the enemy. This simulation was limited in its effectiveness because the rules of play were very complicated and required a large expenditure of time and effort for mastery. This differed from the German simulation in that the Germans possessed combat seasoned officers who could serve as umpires for these simulations (Lee 1990, 43-44).

In 1908, Captain Farrand Sayre published *Map Maneuvers and Tactical Rides.* These were one-sided simulations, which required the services of an umpire to adjudicate action and to serve as the opposing force. The medium for this simulation was maps with plastic overlays. This type of simulation would serve as the benchmark for American simulations through World War II (Lee 1990, 44).

The United States Army focused its simulations efforts on operations research and systems analysis after World War II. The use of these simulations to study history or as a tool for military training was neglected. This focus on operations research simulation allowed civilian software developers to take the lead and develop simulations and wargames as a source of entertainment and education. It was not until the 1980s that the

military would return to developing simulations to meet its needs for training and education (Dunnigan 1992, 146-147).

Today, the military recognizes the benefits of computer simulations for training, research and education. The main advantage of simulations is that leaders are forced to think about how to conduct war at all levels. Simulations facilitate professional discussions, the creation of standard operating procedures (SOPs) and the development of tactics, techniques, and procedures (TTPs). It is these TTPs that soldiers require to fight and win their nation's wars.

A second benefit is that simulations allow the military to create, test, and modify weapons and equipment at a lower cost in time, money, and risk than the dangers of testing these concepts in real life with real soldiers. Simulations facilitate the constant transformation of the military. Simulations allow researchers to experiment with "out of the box" thinking.

Simulations allow a third benefit. They allow a unit or leader to streamline a process or event that normally requires hundreds or thousands of soldiers to execute. Simulations allow a unit or leader to conduct exercises that save money, time, and resources when compared to the events being simulated. Simulations facilitate the execution of multiechelon training and allow high-level headquarters to exercise their wartime or conflict command and control functions.

<div align="center">Limitations</div>

This analysis has some inherent limitations. The scale of this research cannot evaluate all of the commercial simulations available. The population of commercial simulations consists of hundreds of simulations. In fact, there are normally one-dozen or

two-dozen simulations in the military simulation and history genre released monthly. Specific criteria were utilized to identify potential simulations.

These simulations are not without limitations. The primary limitation is that a simulation is only as good as its model. This means that a simulation is not reality. We must remember that we can never truly replicate a freely thinking enemy. Simulations are based on mathematical models.

A secondary limitation of simulations is the absence of danger or a threat of death. A simulation does not require a leader to make decisions that have been tainted by emotion, pain, physical danger or discomfort. Leaders are tempted to take actions that are more aggressive or risky because of the lack of actual repercussions involved in a simulation.

<center>Delimitations</center>

There are several types of commercial simulations that will not be considered for this research. Simulations based on science fiction or fantasy will not be considered. Science fiction and fantasy simulations do support the development of decision making but these simulations do not support the instruction of military tactics. Simulations must be based on history or make use of modern equipment or units.

Simulations that are first person engagement simulations will not be considered. The purpose of this research is not to identify an aid for marksmanship or to develop the hand and eye coordination of junior leaders. These simulations do have their merits. The United States Marine Corps experienced tremendous success with an adaptation to Doom, a popular commercial simulation that is a first-person engagement simulation. The USMC modified the simulation to present training scenarios in an urban combat

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environment with modern weapon systems to include the M4 Carbine, M249 Squad Automatic Weapon and M203 Grenade Launcher. Young Marines enjoyed playing this simulation and improved their urban combat skills with the simulation.

Assumptions

Several assumptions support the research conducted in this study. The first assumption is that all commanders at the company and battalion level have access to a computer. These computers are capable of supporting most commercial simulations with the appropriate hardware and software. These commanders must also have access to a means of projecting or displaying these simulations in order to be incorporated in a training scenario. Examples of projection devices include the digital overhead projector or large screen television.

The second assumption requires that officers and commanders possess some fundamental computer skills. These officers must be comfortable with operating software requiring keystrokes and the use of a mouse. These officers do not require the abilities of computer programmers or software developers.

CHAPTER 2

LITERATURE REVIEW

> Read over and over again the campaigns of Alexander, Hannibal,
> Caesar, Gustavus, Turenne, Eugene and Frederic. This is the only
> way to become a great general and master the secrets of the art of
> war.
>
> Napoleon Bonaparte, Military Maxims of Napoleon

The literature for this topic generally falls into two categories: development of military simulations and recent literature. There is a wealth of information that defines and traces the path traveled from the first military exercises to today's complex computer simulations. A large portion of this material is dated as it relates directly to the topic of this research, but these works can provide some historical linkage to the benefits of modeling and simulation to the military commander. James F. Dunnigan provides a good starting point with his work, *The Complete Wargames Handbook*. He discusses the history and development of wargames. In addition, he establishes credibility for the benefits of military simulations. Dunnigan's book was published in 1990 but remains relevant as an introduction to wargames and simulations. He provides a base source for the beginner in this field.

Peter P. Perla expands on the principles and purposes of military computer simulations in his work, *The Art of Wargaming*. He provides a logical approach to the design, selection and utilization of military computer simulations. His focus of efforts is on the applications of computer simulations to naval operations and naval maneuver. He does provide a valuable approach in the design, selection and use of military simulations. As a longtime gaming hobbyist and a professional wargamer for the Department of Defense, he presents an argument for industry to achieve a better balance between

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professional realism and hobby playability in the development of simulations. In addition, he is a proponent for increased simulation use by the military and provides an argument on how to take advantage of simulation capabilities and how to minimize the limitations of simulations.

John F. Antal provides a written example of the potential of interactive exercises at the platoon level. In his two books, *Armor Attacks* and *Platoon Attacks*, the reader participates in series of interactive fictional scenarios. These are essentially the same actions that occur when a person executes a military computer simulation. His books are an analog version of a simulation and a literary tactical decision making exercise. His work is limited in its application to this topic as he is solely focused on the tactics and maneuvers of an armor platoon and a mechanized platoon in his books.

The United States Army National Simulation Center located at Fort Leavenworth, Kansas, produces a terrific source for leaders who are planning and executing simulations training. This source is known as the Simulations Handbook and also serves as the primary text for a course taught by the U.S. Army Command and General Staff College. The simulations handbook is certainly designed with the regular officer or leader in mind. It is not written with the simulations expert as the target audience. The Army's organizational leaders are the focus of this work. The handbook centers on answering five questions for the reader. Those questions are: What are simulations? Why do we have them? What simulations are available? How do I use these simulations for my training? What happens next? (Simulations Handbook 2002, ii).

The Simulations Handbook establishes the credibility and importance of the use of simulations. It provides a step-by-step approach on how to incorporate simulations into

a unit's training plan. The handbook guides the reader through the delicate task of deciding what tasks a simulation will train and the selection of a simulation. The handbook provides ample examples to include a sample unit training strategy.

The Handbook does identify some shortfalls of simulations in Army training. The Army Family of Simulations (FAMSIM) provides for training from the battalion through corps level. These simulations require the use of a post simulation center and the expenditure of considerable resources to include time and manpower. There is no provision for simulations that support training at battalion level and below and allow the unit to conduct its training in the unit area with unit resources.

The second category of literature is recently published works. The pace of change and development in computers and software is so rapid that many simulations and products are considered obsolete in as few as two years. There are numerous reviews and opinions available on the dozens of current commercial military simulations. I used these reviews as a means to identify potential candidate simulations for my research. Many of these reviews are available electronically and are provided by subject matter experts in the fields of simulation and software. There has been some similar research done by previous Master of Military Arts and Science theses and by members of the School of Advanced Military Studies.

Michael A. Murguia discusses in his article, "Shall We Play a Game?" the strides the commercial sector has made in the development of simulations. The military was the leading developer of simulations when simulations were in their infancy and required a supercomputer for execution. Today, the commercial sector has the lead in software development. Mr. Murguia identifies several reasons for this change of lead. First, the

explosion of video games fueled a demand in the commercial market. Second, competition required developers to refine their simulations in order to meet the demands for increasing realism. Third, the development of hardware facilitated greater strides in shorter amounts of time. The research and development communities of the military could not and cannot compete for the lead in simulations development. The military can however harness the power of the commercial sector (Murguia 2003,2).

Major Bruce Stanley researched in his monograph for the School of Advanced Military Studies the capabilities of commercial simulations for a tool in training. His focus was to examine whether computer simulations can be used to increase the experience level and the decision-making abilities of U.S. Amy leaders. Major Stanley effectively proved the importance of simulations training in a resource-constrained environment and made several recommendations for the use of commercial simulations for training. He does not provide a specific recommendation on how to apply commercial simulations to the training of tactics nor does he identify any potential simulations that the leader could use. He recommended in his conclusion that the U.S. Army incorporate commercial simulations in leader training and the U.S. Army should purchase site licenses for a number of simulations in order that soldiers and leaders of all ranks can participate in this type of training (Stanley 2000, 43-44).

Major Kerry MacIntyre examined the application of commercial wargaming simulations for organizational leadership development. Major MacIntyre focused his research on the ability of simulations to develop the four organizational leadership skills, which are interpersonal, conceptual, technical, and tactical skills, and to perform the three organizational leadership actions of influencing, operating and improving. Major

MacIntyre selected four commercial simulations to analyze against his criteria. He selected 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*. His conclusions were that it might be possible to use commercial simulations to assist in the development of organizational leader skills at a reduced cost to the U.S. Army. He identified in his own conclusion that the small sample size and limited research required further study (MacIntyre 2000, 49-50).

Majors Wayne Cherry and Joseph McLamb of the U.S. Army explored the potential of TacOps, a commercial simulation, as a training tool for officers in the armor and mechanized communities. In their article in the Armor Journal, "Fighting a Hundred Battles," they discuss the shortfalls of using this simulation and recommend some techniques in utilizing this simulation for training. The three shortfalls identified were a requirement by the user to be computer literate, an inaccurate table of organization and equipment for the simulation and an ineffective terrain model that does not provide the level of detail required by most tacticians. These shortfalls are important but all are correctable with suggestions by the authors. The authors provided techniques and procedures for incorporating TacOps into a unit's training program (Cherry and McLamb 2001, 44-45).

<center>Current Army Simulation Initiatives</center>

The Department of Defense has numerous organizations and commands dedicated to developing and fielding simulations for training use. The best example of these efforts are the National Simulation Center (NSC) and the Battle Command Training Program (BCTP), both located at Fort Leavenworth, Kansas. The U.S. Army has dedicated an

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enormous amount of resources toward the development of military computer simulations focused at the brigade level and above. The U.S. Army has not developed much software or material that addresses computer simulations at the battalion level and below.

There are some systems that support this level of training such as the Close Combat Tactical Trainer (CCTT), Close Combat Tactical Trainer XXI (CCTT XXI) and the Simulations Network (SIMNET.) However, these systems require the use and support of several tractor-trailers, the use of battle simulation center and additional non-organic battalion resources and are not conducive to opportunity training or training that relies on the organic resources found at the battalion level and below. Commanders do not have a universal simulation tool that can be used with unit organic resources and conducted in the unit area.

There are many examples of simulation use as a training resource or tool for education and training in the United States Army. The United States Military Academy at West Point, New York, incorporates the use of simulations to teach cadets of all levels the basics of tactics and decision making as a part of the curriculum. The Department of Military Instruction (DMI) teaches cadets a basic course of instruction on small-unit tactics and requires the cadets to apply their new knowledge in making decisions during a real time based simulation. First year cadets conduct exercises utilizing the Dismounted Simulation and Acquisition System (DSAS.) This simulation replicates a dismounted infantry squad and requires cadets to apply the lessons learned in basic tactics at the squad, fire team and buddy team levels.

In follow on classes, cadets utilize simulations to learn tactical fundamentals at the platoon and company level. West Point uses the commercial simulation, Steel Beasts,

to facilitate this training by simulating the actions of a mechanized infantry or armor platoon. The Department of Military Instruction offers electives that utilize simulations to teach the operational and strategic levels of war. The commercial simulation, The Operational Art of War, is used to facilitate these courses. The National Geographic Channel featured a television series entitled, Surviving West Point. In one episode, Studying War, the series focused on the use of computer simulation training during the Military Intercession Training Period.

The U.S. Army Armor School located at Fort Knox, Kentucky, incorporates TacOps Cav, a commercial computer simulation, to facilitate tactics instruction and decision-making exercises for junior captains attending the Captains Career Course and lieutenants attending the Armor Officer Basic Course. TacOps Cav is a map-based, turn- based simulation. The use of this simulation affords military officers the opportunity to plan and execute tactical operations in an environment that requires the application of basic tactical principles and the use of the military decision-making process. This simulation also teaches inexperienced officers the valuable skill of battle command. Battlefield command requires a leader to exercise command in operations against a hostile, thinking enemy. The Armor School uses these simulations to augment their instruction and field training. It is not intended to replace field training but enhance an officer's instruction as he is afforded the opportunity to experience a wide array of environments and exercises.

The U.S. Army Infantry School located at Fort Benning, Georgia, plans to utilize a commercially developed simulation in order to facilitate the instruction of infantry captains and lieutenants. The Infantry School has selected a commercially developed

simulation, Full Spectrum Command. Full Spectrum Command is the product of a collaborative effort by the Institute of Creative Technologies (ICT) and the Simulation, Training, and Instrumentation Command (STRICOM.) As the commander of a U.S. Army light infantry company team, the student commander must interpret the assigned mission, organize his force, develop a plan, and coordinate the actions of about 120 men under his command.

The most striking feature of Full Spectrum Command is the incorporation of an explainable artificial intelligence. This feature allows the simulation AI to provide its reasoning for tactical actions. This information is a key element to providing an effective after action review. This has facilitated an increase in the amount of instruction and training officers can receive by simplifying the overhead of conducting maneuver. Officers can make mistakes and correct them faster than if all of the instruction were conducted in a real environment with real soldiers and equipment. This instruction does not replace live realistic field training but only serves to enhance the total training package by making the best use of training resources (U.S. Army Infantry Homepage).

Full Spectrum Command has the ability to incorporate a map board or game board into the exercise. The purpose of the Full Spectrum Command board game is to facilitate the tactical understanding of firepower and maneuver at a company level in an urban combat environment. The game play is scenario-based and two-player, with one player commanding a conventional light infantry company while the other player commands a group of asymmetric cells. The game incorporates a tile-based playfield in order to facilitate battlefield maneuver and provides for indirect fire as well as aerial reconnaissance (Institute of Creative Technology Website).

The U.S. Army Command and General Staff Officer's Course (CGSOC) and the School of Advanced Military Studies (SAMS) both utilize computer simulations to enhance and develop their students at the tactical, operational and strategic levels of war. CGSOC requires all of its students to participate in computer simulations at the brigade through corps level during Terms II and III. CGSOC uses many different simulations to include several of commercial design. CGSOC utilizes Decisive Action (DA), Interactive Gaming Simulation (IGS), and TacOps Cav to conduct simulations at the brigade through corps level. SAMS uses the commercial simulation, The Operational Art of War, to execute its practicum events. These events integrate the instruction of military history, theory and doctrine and allow students to apply the lessons and knowledge presented in the course of instruction to a scenario requiring the planning and conduct of a campaign at the operational level of war.

The United States Army invests a large amount of time, resources and personnel in the Battle Command Training Program (BCTP.) This program plans, executes, and evaluates division and corps level simulations for all units in the Army, both active duty and reserved component. BCTP provides an electronic enemy force known as the World Class Opposing Force (OPFOR.) The importance and benefits of these simulations are recognized throughout the U.S. Army. Simulations are used at all levels from platoon through theater to enhance the Army's readiness and knowledge. Simulations are used in nearly every major command to include the Training and Doctrine Command (TRADOC) and Forces Command (FORSCOM) with great success.

The fast paced advancement of computers and software and the computer abilities of the Army's junior leaders provide the commander with an opportunity to enhance

training through simulation. All units possess the very basic resources required to conduct simulation training. Those resources are an off-the-shelf 1.2 GHZ Personal Computer (PC) with 256 megabytes (MB) of random access memory (RAM) and a CD-ROM and either a digital projector or a large screen television. I will research how the commander can conduct simulation training with only his battalion task force organic resources in order to teach tactics and decision making to his junior leaders. The training objectives of this simulation training are to develop better decision-making abilities in subordinates and to demonstrate an understanding of tactics at the battalion task force level and below.

Developing better decision-making abilities in subordinates is defined by the requirement to execute several identifiable tasks. These tasks are: develop a plan, implement a plan and adjust a plan based on changes in situation awareness. These tasks are measurable and provide specificity of a commander's training intent for the use of simulations.

Demonstrating an understanding of tactics at the small unit level requires a junior leader to accomplish tasks related to the science of tactics. FM 3-90, *Tactics* defines tactics as the employment of units in combat. Tactics is further divided into the science and art of tactics. The science of tactics encompasses the understanding of those military aspects that can be measured and codified such as capabilities, techniques and procedures. The art of tactics consists of three interrelated aspects: the creative and flexible array of means to accomplish assigned missions, decision making under conditions of uncertainty when faced with an intelligent enemy and understanding the human dimension of combat. A junior leader displays the science of tactics when he

employs units and weapon systems in a combined arms operation and when he uses fire

and movement to maneuver on the battlefield. Simulations allow us to directly train the

science of tactics. The art of tactics is much more difficult to train because of the

limitations in modeling the human dimensions of the battlefield.

CHAPTER 3

RESEARCH METHODOLOGY

> It is essential that all leaders--from subaltern to commanding
> general--familiarize themselves with the art of clear, logical
> thinking. It is more valuable to be able to analyze one battle
> situation correctly, recognize its decisive elements and devise a
> simple, workable solution for it, than to memorize all the erudition
> ever written of war.

Infantry in Battle, 1939

This research is a pilot study to determine the feasibility of using off the shelf commercial simulations in order to teach tactics and decision making at the battalion level and below using only the organic resources of the unit. A limited number of personnel will be utilized in the evaluation and comparison of simulations. The phases of research were: background research, selection of simulations, evaluation, and comparison.

Selection of Simulations

The selection of a few computer simulations from the hundreds available was a daunting and potentially overwhelming task. A quick search of the Internet for military computer simulations returned nearly one thousand programs of different types and capabilities. I established some basic criteria in order to determine a base list of potential simulations. These criteria established some important baseline requirements that were non-negotiable in order to support the level of training desired and in order to pair down the hundreds of potential simulations.

The first two base line requirements are that all simulations must be PC-based and currently available on the commercial market. A simulation would provide commanders little assistance as a training aid in training soldiers if a recommended simulation was not

readily available or required the unit to purchase or acquire new computer equipment or hardware for the sole mission of supporting this training. These simulations must support training to be conducted by field commanders with basic computer equipment available to the average unit.

Simulations must have a focus on military tactics or strategy in a realistic setting. This criterion excludes simulations of the science fiction and fantasy genres. Simulations of these two types support decision making but do not afford a leader the opportunity to utilize modern equipment, capabilities and units in the execution of this decision making or in the application of tactics, techniques and procedures of the United States Army. The simulation must represent the actions of modern forces or be based in a historical setting that is conducive to research and study by the officer.

An additional base-line requirement for the simulation is to be representative of 20th Century modern warfare. Although an argument can be made that the basic components of maneuver warfare have existed since the 1700s, there are major fundamental differences in the tactics, techniques and procedures of maneuver warfare since that time. The impact of technology has facilitated the refinement of the art and science of warfare. Simulations that do not allow a user to use current equipment and tactics run the risk of developing and reinforcing unsound tactics. An example of this is in the application of mass. In World War I, mass was considered the application of combat power to a point on the battlefield. Today, we are more concerned with the massing of the effects of combat power.

Four different organizations in the United States Army have recently conducted similar reviews of off-the-shelf commercial simulations for the purpose of instruction in

tactics and the development of effective decision making. The United States Military Academy, the United States Army Infantry School, the United States Army Armor School and the United States Army Command and General Staff College all utilize commercial simulations. However, it is important to note that each school uses different simulations for similar or nearly similar purposes. Those purposes are to facilitate the instruction of tactics and decision making at the platoon through corps level. Without being parochial, it is beneficial to analyze and determine if one simulation is better suited to support the commander's training plan.

The simulations selected were: TacOps Cav, Steel Beasts, The Operational Art of War, and Full Spectrum Command. These simulations are all available commercially and meet the base-line requirements identified in the previous paragraphs. All of these simulations are currently in use by different elements of the U.S. Army training and education systems.

<div align="center">Candidate Simulation Overviews</div>

TacOps Cav

The United States Army owns the proprietary rights to this simulation and provides it to all members of the United States Army for use as a simulation tool. It can be obtained from most post battle simulation centers or by contacting the Armor School (see figure 1). TacOps Cav is a constructive simulation of modern tactical combat. It is turn-based and allows the user to utilize all current capabilities of the United States Army and the United States Marine Corps (USMC) to include close air support by both rotary and fixed wing aircraft. The simulation supports the use of fire support assets and

engineer support. This simulation is utilized by foreign militaries as well to include units
and schools of the Canadian Army and the German Army.
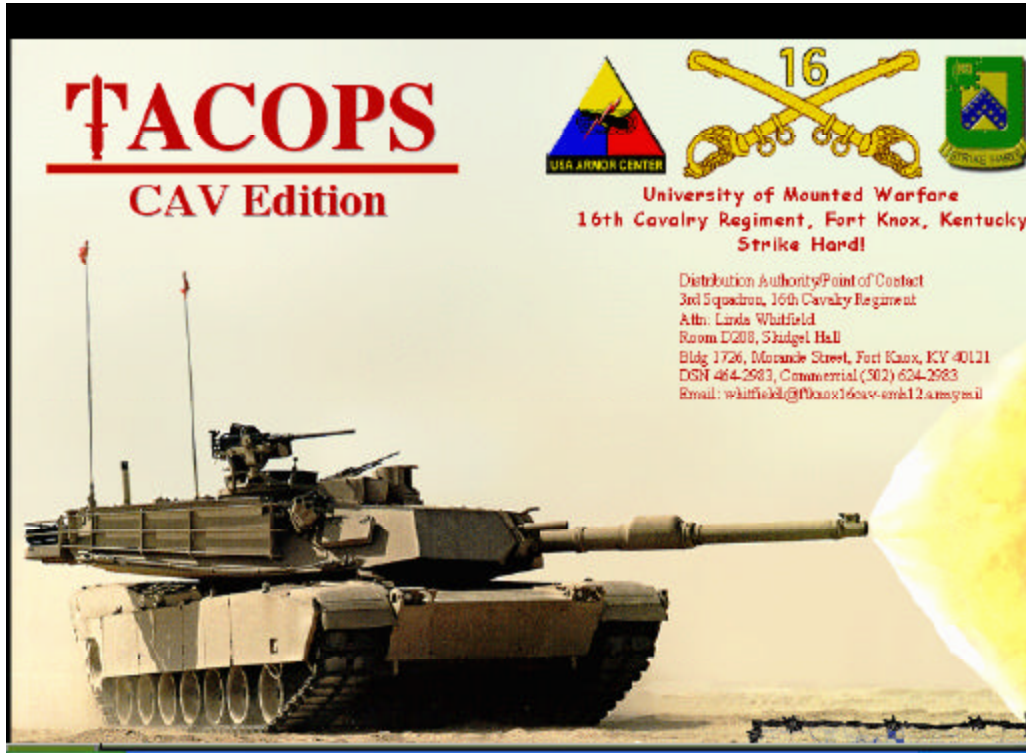
Figure 1. Screenshot from Tac Ops Cav

The simulation has a database of missions to select from and the editor allows a
commander to construct scenarios of different missions, terrain types and unit orders of
battle. The database does contain a large number of the U.S. Army's most used training
areas such as the National Training Center at Fort Irwin, California (see figure 2). The
map database includes a diverse collection of terrain to include jungles, urban areas and
deserts. The settings for some of the scenarios include Afghanistan, South Korea, Brunei

and Germany. The scale of the simulation allows the user to define the length of turn and the scale of the map. The user can establish and utilize graphic control measures. The scenarios are presented in operation order or fragmentary order format in accordance with the United States Army doctrine and FM 101-5-1, Operational Terms and Graphics.

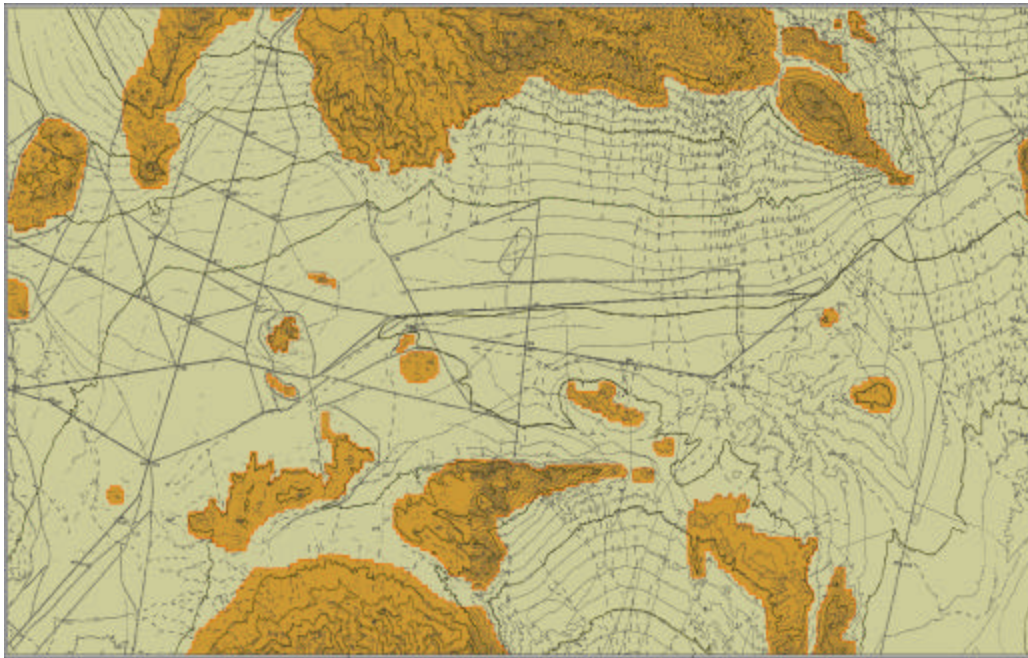Figure 2. NTC Map from Tac Ops Cav

Steel Beasts

Steel Beasts is a highly accurate simulator of the US M1A1 and German Leopard 2A4 tanks and was designed to support the creation of scenarios of modern armored warfare at the company team level and below. Steel Beasts can be played on many different levels from that of a crewman on a single tank to company commander. All

missions and scenarios can be conducted over a network (e.g.,the Internet) with any combination of cooperative and competitive style of play, including multiple players in a single tank.

The scenario and map editors allow commanders to create virtually any mission imaginable. The individual mission (or scenario) is the core of Steel Beasts. Each mission has three distinct phases. The planning phase, in which a military-style text briefing and interactive maps are presented for planning the mission. The execution phase, in which the simulation runs in real time, and the user can experience the virtual three dimensional battlefield from a first-person point of view in the tank commander's or gunner's position, or from an external view, in combination with a military-style map with the appropriate operational graphics and symbols (see figure 3).

The third and final phase is the debriefing phase, in which the results of the scenario are displayed, along with key events during the mission. The terrain-rendering engine enables users to conduct an intelligence preparation of the battlefield. Steel Beasts incorporates multiple types of forces to include mechanized and light infantry. Artillery, minefields, smoke operations and urban areas are incorporated into Steel Beasts.
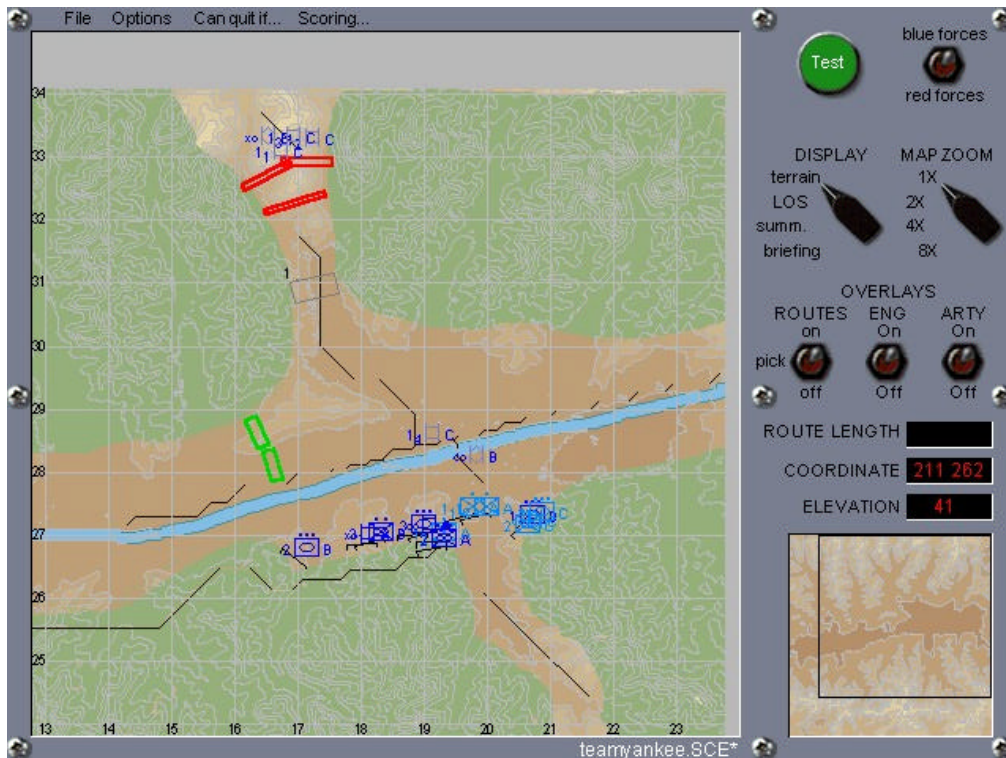
Figure 3. Screenshot from Steel Beasts

The Operational Art of War: Century of Warfare

Talonsoft, Incorporated produces this simulation and retails the simulation for approximately forty dollars. This training tool is a combined simulation and scenario editor that spans numerous military campaigns and battles of the twentieth century. These scenarios include all of the major conflicts and wars that the United States has fought or participated in during this century. These scenarios include World War I, World War II, the Korean War, the Vietnam War, and the Persian Gulf War of 1991. The simulation also includes many hypothetical scenarios to support a wide range of options in the scenario editor.

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This simulation is turn-based and incorporates enough flexibility to simulate forces from platoon to corps level. Information is displayed on a map board that is flexible in scale from one grid square equaling two and a half kilometers to one grid square equaling fifty kilometers (see figure 4). It allows the user to select from a wide range of options to support simulation execution such as difficulty of play, the incorporation of weather and the level of detail for battlefield reporting. The user can determine the amount of intelligence available to either side, and configure the relative strengths of the combatants in order to replicate a lack of parity on the battlefield.

Figure 4. Screenshot from The Operational Art of War, Operation Urgent Fury, Grenada

This simulation has a database that supports all of the major conflicts on the twentieth century and the terrain database that support these conflicts. In addition, the

database includes all of the major types of United States military units to include

mechanized, armor, airborne, air assault and light forces and their respective capabilities

in terms of modern equipment and organizational structure. The simulation incorporates

fire support, air support and engineer operations. Joint operations are not limited to only

land and air integration but include naval and marine forces.

Full Spectrum Command

The Full Spectrum Command project models the command and control of a U.S.

Army light infantry company in a military operations in urban terrain (MOUT)

environment and is targeted at future company commanders. The user takes on the role of

a company commander in a series of scenarios designed to develop their cognitive skills,

tactical decision-making abilities, resource management and adaptive thinking. The

scenarios incorporate asymmetric threats and are focused on peacekeeping and peace

enforcement operations. The setting for these operations is in Eastern Europe (see figure

5).

Scenarios are currently being developed in conjunction with the Infantry School

at Fort Benning. This close coordination will ensure the project remains doctrinally and

tactically accurate. The simulation will include an AAR assistant that will feature an

"Explainable AI." This "Explainable AI" will provide essential feedback on the plan the

computer fought. A user-level editor for scenario customization is included as well as an

instructor evaluation mode for curriculum-based usage. This simulation is being custom

designed to reflect the current operational TTPs and small unit tactics for the U.S. Army.

Figure 5. Screenshot from Full Spectrum Command

Analysis Criteria

The criteria selected for analysis serves to determine how effectively a simulation supports the training objectives of tactics instruction, decision making and the resource requirements at the battalion level and below. These simulations replicated tactical actions at the battalion task force level and below. No simulation will replicate the actions of soldiers and leaders perfectly. However, certain tactical principles must be simulated in a correct manner in order to prevent the development, execution, or reinforcement of unsound tactical principles, concepts or procedures. I utilized a matrix to analyze, evaluate and compare the simulations. All criteria are weighted evenly.

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A numerical value between one and five was utilized for the evaluation with low numbers being viewed as better than a higher number (see table 1).

The analysis criteria were divided into three categories. Those categories were: tactics, decision making, and user requirements. These categories support the research question of this study. The subcomponents of the tactics category support the instruction of tactics. The subcomponents of the decision-making category support the implementation and evaluation of decision making. The user requirements determine the ability of a commander to utilize a simulation as a training aid.

Demonstrating an understanding of tactics at the small unit level requires a junior leader to accomplish tasks related to the science of tactics. FM 3-90, *Tactics,* defines tactics as the employment of units in combat. I defined the employment of the science of tactics as the ability of a simulation to support four events. The first event is the employment of units in combined arms operations. Combined arms operations is the synchronized or simultaneous application of several arms such as infantry, armor, and artillery to achieve an effect on the enemy that is greater than if each arm was used against the enemy separately or in sequence.

The second event is the employment of fire support. The simulation must support the planning and employment of indirect fire assets and close air support. This employment included realistic effects on the enemy. The simulation must not afford an unrealistic amount of support or support that is more responsive than normal.

The third event is the utilization of a modern task organization and current United States military equipment. The simulation must support the use of the primary types of maneuver forces to include mechanized infantry, armor, airborne, air assault and light

forces. The simulation must support realistic training and allow a commander to train with the assets with which he will fight our nation's battles.

The fourth event is that logistics must be conducted with some level of fidelity. The simulation must not allow an unlimited amount of resources. A unit's performance should be limited to its logistics resources or capabilities.

	Table 1. Analysis Matrix												
	Criteria												
	Tactics				Decision Making			User Requirements					
	Employ Combined Arms Operations	Employ Fire Support	Utilize Modern Task Organization and Equipment	Conduct Logistics w/ fidelity	Conduct Troop Leading Procedures	Update Situation Awareness	Convey Orders in a Time-constrained Environment	Human OPFOR Capable	Network or LAN capable	Ease of Scenario Building	Family of scenarios	Save and Pause Feature	AAR Supportable
Steel Beasts													
TAC OPS CAV													
TOAW													
Full Spectrum Command													

Decision making is defined by a simulations ability to meet three requirements. The simulation must support the user's ability to conduct troop-leading procedures. The

ability to conduct troop-leading procedures is a standard task for maneuver forces. This task is supported with training evaluation and outlines in the mission training plans. The base elements of this require an order to be received and the ability to conduct planning.

The second requirement is the ability to update situational awareness through the use of reports and a common operating picture. The common operating picture should be displayed on a map screen and utilize unit icons and operational graphics to display the current situation. Updates should be provided in the form of situational reports from subordinate units. The common operating picture should only be based on the ability of a commander to see an event or his subordinates to see an event. The fog of war prevents a commander from possessing perfect vision and situational awareness; simulations should replicate the fog of war.

The third requirement is the ability to convey orders in a time-constrained and information-constrained environment to subordinates. The user must be able to direct his subordinate units through some form of combat order or standard operating procedure.

In order to support training at the battalion level and below, I have established several requirements in order to facilitate a unit's resource capabilities. A simulation should allow the opposing force to be controlled by another person in order to support the training objectives of a simulation. This allows a commander to control the actions and reactions of the enemy in support of achieving the desired training objective.

A simulation must support the networking of computers in order to allow for multi-player scenarios. This networking facilitates the establishment of a leader and subordinate relationship on the battlefield. Units may also incorporate radios as means to convey orders and reports for battlefield tracking.

The simulation must support the ability to create, edit or alter scenarios. Multiple scenarios allow a commander to conduct training in support of a majority or all of his mission essential tasks. This flexibility will allow for creative and adaptive training and prevent repetitive training that results in rote actions by subordinates.

The simulation should possess pause and save features in order to facilitate command and control of the simulation. A simulation must also support the conduct of after action reviews (AARs). AARs require raw data on how a unit performed and accomplished or failed to accomplish a mission. The simulation must provide raw data such as friendly and enemy casualties, ammunition expenditures, and damage sustained.

CHAPTER 4

ANALYSIS

> The tactician learns to cut to the heart of a situation, recognize its important
> elements, and base his decisions on those important elements as he masters his
> profession. The ability to do this cannot be acquired overnight. A tactician
> develops this capability after years of schooling, self-study, and practical training
> experiences, which eventually develop the intuitive faculties required to solve
> tactical problems. He rarely gets the opportunity to practice the science and art of
> tactics under actual combat conditions.
>
> FM 3-90, *Tactics*

Study Participants

The participants of this pilot study included U.S. Army officers from several

different branches to include infantry officers, armor officers, an engineer officer and a

military intelligence officer. These officers are all in the rank of Major in the United

States Army and five of the six are students at the U.S. Army Command and General

Staff College. One officer is in attendance at the School of Advanced Military Studies

(SAMS) and two of the officers will attend SAMS next year. These officers have served

in all of the basic types of conventional units in the U.S. Army to include mechanized,

armor, airborne, light infantry and air assault units.

These officers possess computer skills that they identified as beginner level to

intermediate levels of expertise. Their computer simulations experience ranges from a

casual interest in simulations to a desire to participate in gaming conventions and

simulations clubs. All of these officers have participated in simulations training at the

brigade level and above to include the U.S. Army's Warfighter series of exercises

conducted by the Battle Command Training Program. Half of these officers have

participated in or conducted simulations training at the battalion level and below to

include JANUS, CCTT, UCOFT and SIMNET. Half of these officers conducted

simulations training at the company level and below in their previous assignments as

company commanders. Two of these officers utilized off the shelf commercial

simulations to teach tactics and develop decision making in subordinate leaders in

previous assignments as company commanders and instructors.

These officers conducted the study independently and utilized their home

computers to operate the selected simulations. I provided either a free demo of the

simulation or the entire simulation program. No copyright laws were infringed or broken

in the course of this simulation. They spent an average of eight hours in order to evaluate

the simulations. Several officers required more time because they were not familiar with

one or more of the simulations from previous assignments. No officer exceeded 12 hours

to complete the study.

<div align="center">Simulation Performance</div>

Full Spectrum Command

This simulation was not available for analysis due to a delay by the Institute of

Creative Technologies in providing a full feature demo or working simulation to the

United States Infantry School at Fort Benning, Georgia. The Infantry School has

conducted some initial testing with officers enrolled in the Captains Career Course.

These officers utilized a limited feature demo that has demonstrated a viability of the

simulation to serve as a teaching and training tool.

The simulation may prove to be useful to a commander as not just a training tool

but also as an aid in planning and conducting rehearsals. The Infantry School and the

Institute of Creative Technologies intend to continue the Full Spectrum Command project

<div align="center">36</div>

by expanding the database of missions and scenarios. In addition, the project will expand the supported terrain database from the current two-kilometer square training box to a database that supports training worldwide.

<u>Tac Ops Cav</u>

<u>Strengths</u>. This simulation was liked by all of the study participants because it is tactically focused and could serve as a good tool for training subordinate leaders. The study found this program to be easy to use and was navigated easily with either the mouse or keyboard. This simulation allows for detailed mission planning and the employment of combined arms operations. This simulation allows for the synchronization and integration of the BOS elements.

The layouts of the scenarios are effective at facilitating the training of the mission orders process. The simulation provides quality reports that enhance a commander's situational awareness without compromising the requirements of simulating the fog and friction of war. The simulation also provided sufficient information, reports and screenshots to support the planning and execution of an after action review.

The scenario editor and the diverse equipment database facilitate the development of countless scenarios to support the unit's training objectives. Tac Ops Cav represents realistic battalion task force assets and their availability to the company team commander. Commanders are not supported with unrealistic amounts of artillery or close air support. Units can configure the responses of units in the simulation based on their own standard operating procedures (see figure 6).

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Figure 6. SOP Editor for Tac Ops Cav

Weaknesses. Tac Ops Cav depicts terrain in a two-dimensional environment.
Altitude or elevation and terrain relief are not represented. This two-dimensional
limitation limits the realistic simulation of line of sight and fails to reward or punish the
leader who chooses "bad ground" to defend or attack. This simulation is not appealing
graphically. The maps appear to be artistic in nature and do not portray information in the
medium of a military map. This simulation is difficult to use for multiplay. It supports
head-to-head competition but does not support multi-player execution, which would be
required for use by a commander and his subordinates.

Steel Beasts

Strengths. This simulation is tactically focused at the individual vehicle through
platoon and company level. It is a good tool for teaching rapid decision making to junior
leaders. The target audience for this simulation is junior leaders in the rank of captain to
sergeant. The command and control incorporates many realistic elements of the fog of

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war. A commander is limited in the information that can be relayed on the command net. The command net is susceptible to damage or jamming. The leader is limited in situational awareness to only the information presented by the unit reports. Because Steel Beasts is a real-time based rather than turn-based, the commander and his subordinates are limited in time to make a decision or to implement orders. This forces the user to make decisions quickly and efficiently in a time-constrained environment which is a skill required of the military leader.

This simulation provides a realistic impact of terrain on survival and mobility. Terrain is represented in three dimensions. A unit's elevation is modeled by limiting line of sight and visibility. In addition, units that do not use terrain that mask a unit from observation and enemy fire experience realistic repercussions from poor terrain management. The graphics of the simulation support the depiction of vegetation in a restrictive terrain environment.

This simulation is very easily configured for multi-player use or local area network (LAN) play. A commander could easily fight a scenario with his subordinates connected by LAN in a manner very similar to CCTT, JANUS or SIMNET. This simulation has a large civilian following. There are simulation clubs and websites dedicated to this simulation. These sites contain a database of scenarios available for free download.

Weaknesses. Logistics is not modeled or represented in any fashion in this simulation. This simulation focuses on mechanized and armor operations and minimizes the incorporation of light infantry operations. The simulation would be difficult to use for battalion task force level training but perfect for company level and below.

<u>The Operational Art of War</u>

       <u>Strengths</u>. This simulation was enjoyable to play but the members of the study found it lacking in application at the battalion level and below. This program is a terrific tool for the commander and staff at the operational level of war. This simulation possessed a tremendous flexibility contingency planning since its database encompassed forces and terrain sets from the entire globe. The scenario editor allows for any modification to the scenario in order to support the desired training objective. This program was incredibly easy to use and required the least familiarization time in order to learn to use the program.

       <u>Weaknesses</u>. None of the scenarios allowed the user to instantly focus on battalion level and below. In order to support operations at the battalion level and below, a commander would have to build his own scenarios. This process could be very time intensive based on the commander's desired level of complexity. Logistics was modeled in only the abstract form.

<div align="center">Criteria Analysis</div>

<u>Tactics</u>

       Steel Beasts and Tac Ops Cav were nearly identical in performance for the purpose of tactics instruction (see table 2). Steel Beasts was slightly better for two reasons. First, the terrain engine in Steel Beasts was three-dimensional which allowed terrain relief to be considered in the employment of units. The Steel Beasts map screen included a better line of sight tool that allows the user to conduct a proper terrain analysis and to conduct his maneuver utilizing the appropriate fundamentals of fire and maneuver. Second, Steel Beasts utilizes a common operating picture that includes a military style

map, military unit icons and operational graphics consistent with U.S. Army doctrine. This common operating picture allows the user to analyze the current situation of the scenario in a manner consistent with most command post operations.

Table 2. Final Analysis Data													
	Criteria												
	Tactics				Decision Making			User Requirements						
	Employ Combined Arms Operations	Employ Fire Support	Utilize Modern Task Organization and Equipment	Conduct Logistics w/ fidelity	Conduct Troop Leading Procedures	Update Situation Awareness	Convey Orders in a Time-constrained Environment	Human OPFOR Capable	Network or LAN capable	Ease of Scenario Building	Family of scenarios	Save and Pause Feature	AAR Supportable	TOTALS
Steel Beasts	1.66	1.5	1.5	2.5	2.0	1.8	1.8	2.2	1.3	1.7	1.7	1.3	1.5	22.5
TAC OPS CAV	1.66	1.5	1.5	2.5	1.8	1.7	2.5	1.5	1.2	2.0	1.8	1.3	1.5	22.5
TOAW	2.83	3.1	2.2	2.2	3.2	2.8	3.3	1.8	2.0	2.7	2.2	1.7	2.3	32.3
Full Spectrum Command	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E

The Operational Art of War did allow for the employment of combined arms operations. However, these actions were not specific to allow for the synchronization of the BOS elements. The other two simulations required the user to develop the timing of an action and to position assets accordingly. In the Operational Art of War, this timing was automatic. All three simulations allowed the user to combine the effects of maneuver

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forces with close air support, fire support and engineer support. Tac Ops Cav requires the commander to synchronize the actions of his supporting arms. The commander must take all of the actions of a live mission to include marking the target, adjusting artillery fire for a non-registered target and finally target refinement. Tac Ops Cav requires the commander to plan for the use of his supporting assets and to sequence them according to their availability (see figures 7 and 8).
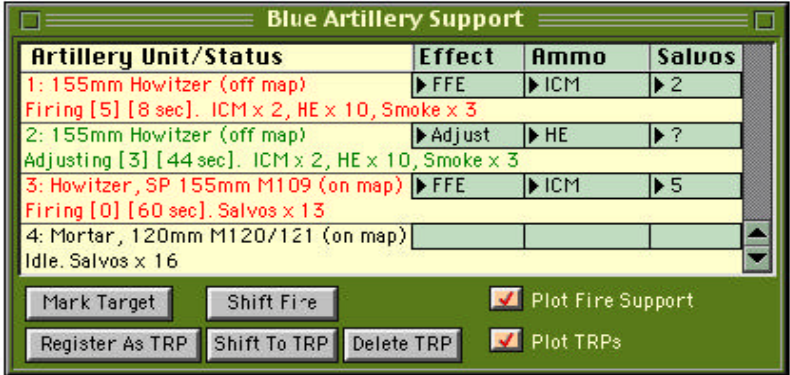

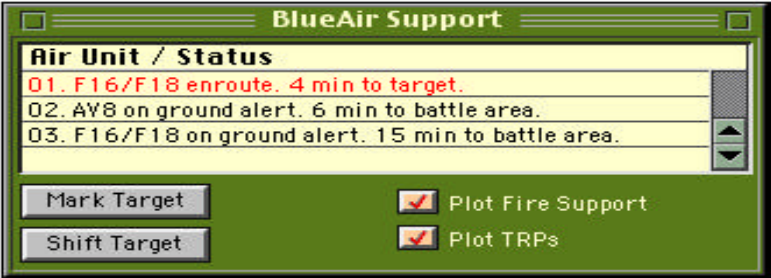Figure 7. Blue Force Artillery Planning Tool for Tac Ops Cav

Figure 8. Air Support Planning Tool for Tac Ops Cav

Logistics was poorly simulated in all three simulations. Steel Beasts and Tac Ops Cav did track ammunition expenditures, however there was no provision for the

consumption of fuel nor was their any means to request resupply. The Operational Art of War automatically resupplied a force as long as it maintained a viable line of communications. In other words, supplies continued to flow as long as the enemy did not surround your force or isolate you from your higher headquarters. In none of the simulations was the commander required to conduct sustainment operations in the form of logistics resupply operations (LOGPAC) in order to rearm or refuel the force.

Decision Making

Tac Ops Cav supported the task to train decision making slightly better than Steel Beasts and much better than The Operational Art of War (see Table 2). Tac Ops Cav and Steel Beasts both require the commander and his subordinates to think "on their feet" and to respond in a time-constrained environment. Tac Ops Cav and Steel Beasts both allow the commander to command and control his unit by initially developing a plan based on an operational order and then communicating his orders via radio or message text. Steel Beasts does require the commander to respond to an active enemy since the other two simulations are turn-based and allow a user to endlessly consider his next action or inaction.

Steel Beasts and Tac Ops Cav develop a commander's situational awareness through situation reports and updates to the common operating picture. The commander is only presented information that he sees or information that units he is in contact with can see. This situational awareness is in stark contrast to The Operational Art of War. The Operational Art of War presents nearly perfect situational awareness. Steel Beasts replicates the inability to communicate with a subordinate unit by simulating a loss of radio contact due to interference or battle damage to the communications system. The

other two simulations simulate a near perfect communications system. One of the challenges with The Operational Art of War is the requirement to filter information. Reports are sent from all of the units in an organization and the commander must determine what information is or is not important.

Steel Beasts and Tac Ops Cav provided scenario briefings in an operation order format. These operation order formats permit units to conduct troop-leading procedures and to utilize the military decision-making process to develop a plan of action. The Operational Art of War provided information in a standard text format that was not consistent with a traditional military order. These briefings would have to be rewritten in order to support a unit's training objective. All three simulations support the training task of developing a plan. Steel Beasts and Tac Ops Cav were easier to use in the development of the plan. This ease of use was due to the manner in which the information was presented.

User Requirements

All three simulations were comparable in capability with regards to control of the opposing force, the ability to create a LAN simulation network and incorporation of a scenario editor. All three simulations allowed the user to configure the system for single player play or multiple player play. In addition, either a human or the computer could control the enemy force. The level of difficulty was controllable for all three simulations from easy to extremely difficult. The scenario editors were simple to operate in all three simulations and provided all the tools necessary to adapt or create scenarios to support

specific training requirements. Those tools included the ability to create and edit maps, databases and game specifications.

The after action review (AAR) feature of Steel Beasts provided data that many soldiers would recognize as information similar in content to that provided at the maneuver training centers of the U.S. Army. Steel Beasts provides playback of all key events, all reports and all enemy contact. The data includes who engaged whom first, the result of the action, an assessment of casualties and damage and the time of the event. This information is all presented on the map screen and allows the commander to fully understand the context of the event (see figure 9).

Tac Ops Cav provides information for AAR's but not in a manner that is as graphically detailed as the AAR tools in Steel Beasts. Tac Ops Cav does provide sufficient data to produce a quality after action review. There is no provision for an AAR tool in The Operational Art of War. The Operational Art of War simulation provides only a determination of whether a unit succeeded or failed in accomplishing its assigned missions. The user would have to keep a record or log of critical events in order to provide the amount of data required for an effective after action review.
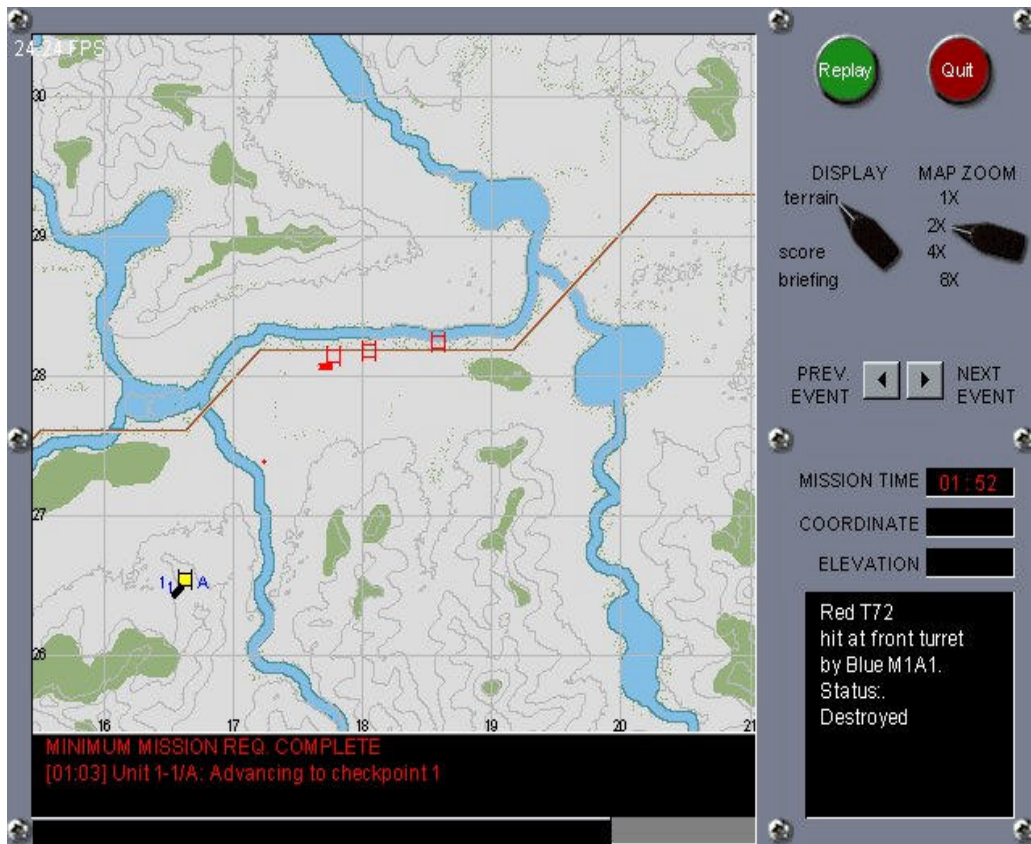
Figure 9. AAR Screenshot from Steel Beasts

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

> Take notice: Simulation training and training devices are the high-tech training trends of the future. Like it or not, the Army simply can't afford the ammunition, gas, and maintenance required for every training event. However, keep everything in perspective. Simulators and training devices supplement other training. When you do supplement your training, try to use the best state-of-the-art equipment. In many ways, your soldiers get more effective, controlled training using simulators because the feedback if immediate.
>
> COL John G. Meyer, *Company Command: The Bottom Line*

With the tutelage of my research committee and the dedication of my fellow officers, this pilot study was a successful foray into how simulations can support the commander in the field as a training tool for use at the battalion level and below with a unit's organic resources. This study was enlightening for me as well as challenging until the very end. This study accomplished several actions. First, the study confirmed the benefits and advantages that simulations provide to the commander. Specifically, simulations allow a commander to conduct and support training in a resource-constrained environment. I reviewed the different simulations available to the commander and described the efforts the U.S. Army has placed into simulations and simulations research.

Second, a commander must clearly identify training objectives that he wishes to accomplish through the use of simulations. In order to properly select a simulation to support a training event, the commander must decide what tasks he wants to train and to what fidelity each of those tasks must be trained. The level of fidelity required will often determine which type of simulation will best support the training.

Third, no single simulation will fit the needs of all commanders and the training requirements of all units. Steel Beasts was liked by all the members of this study and

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achieved the best score overall statistically. Steel Beasts serves the mechanized and an armor community well as a training tool but meets the needs of the light infantry community poorly. None of these simulations would satisfy the training requirements of engineers, field artillery, aviation units and other units represented across all of the battlefield operating systems.

Some Recommendations for Further Research

This study suggests several aspects for further research. Commanders must deal with increasing amounts of new information. Commanders could realize some benefits from simulations that present a large amount of diverse information from subject areas that the commander is not necessarily well versed. Examples of these simulations are programs that require a commander to build a product, a city, or an industry. These simulations would develop the analytical skills and decision-making abilities of the commander. These types of training events could be provided at very little cost to the U.S. Army.

Another aspect for further research is the study of historical simulations. Units could gain some benefits from the use of historical simulations that are linked to the unit's purpose or history. A unit that is expected to conduct a complex operation such as a river crossing could expand its situational awareness and doctrinal understanding by utilizing historical simulations to understand the sequencing of this complex operation. The challenge of this research would be to identify simulations that would reinforce the appropriate doctrine and tactical fundamentals.

Some Recommendations for the U.S. Army

Based on the work presented in this study, there are opportunities for further study and research. I would recommend three possibilities for further study and action by the United States Army.

First, the United States Army should formally charge each United States Army Branch training center or the National Simulations Center to conduct similar studies of a larger nature in order to identify other off the shelf commercial simulations that would support battalion level training. The U.S. Army should purchase licensing rights to the simulations selected and publish an authorized simulation list in order to support the commanders in the field.

Second, the United States Army should encourage the use of simulations to augment live training. Army doctrine includes very little guidance on the incorporation of simulation training at the battalion level and below. It is not mentioned at all in the U.S. Army's latest version of FM 7-0, *Training the Force*. In addition, nearly all of the members of this study remarked most units had policies that prevented the use of simulations on government computers. These policies are normally oriented on "video games" but these policies must be rewritten to provide commanders the latitude to utilize off the shelf commercial simulations.

Third, the U.S. Army must endeavor to produce doctrinal publications to guide and educate the U.S. Army on the conduct of simulations and simulations training. Simulations training are not mentioned in the newest version of FM 7-0, Training the Force. There is a lack of doctrinal information available to guide the commanders in the field on how to plan and conduct simulations training.

Some Recommendations for Industry

The military does not have the resources or the expertise to design and produce its own software and simulations. Industry must continue to expand, develop and market a suite of simulations that support the training requirements of the military. These simulations should incorporate our current and future technologies; utilize military terminology and present information in a manner recognizable to the soldier and leader. Simulations should support not just combat operations but should also support the entire full spectrum of conflict, from peace keeping to conducting combat operations.

There is already a sizeable consumer market for these simulations; incorporating these ideas will only serve to expand that consumer market at a very minimal cost to the industry. Steel Beasts has such a sizeable following in the civilian sector that the program is sold out and there is currently a six-month delay in delivery due to the huge demand. This demand has spawned several websites dedicated to Steel Beasts. These web sites have hundreds of scenarios available for download for free.

Conclusions

This pilot study suggests that is possible to utilize off the shelf commercial simulations as training tools for tactics instruction and the development of decision making at the battalion level and below. The small sample size of this study clearly indicates that additional study should be conducted to identify a suite or list of simulations that support tactics instruction and the development of decision making. The current simulations assets for training at the battalion level and below require the use of organic resources and a simulation center.

Simulations training are the solutions to the current challenges of effective training in a resource-constrained environment. Units are currently not resourced with enough money to accomplish all training in a live manner. The most effective means to offset this lack of resources is through the use of effective simulations training at all levels of command. Simulations training will never replace live training. Off the shelf commercial simulations offer a cost effective, high payoff, time saving training tool for training at the battalion level and below.

GLOSSARY

For this research, there are several key terms that must be defined in order to establish uniformity for discussion and understanding. Most of these terms are common to the military professional but require a common definition to prevent misunderstanding. This is not an all-inclusive list but an initial list that will aid in the delineation of the scope of the research.

Air defense system. This battlefield operating system (BOS) is the employment of active measures designed to nullify or reduce the effectiveness of attack by hostile aircraft and missiles. Simulations must afford the force a means to properly defend itself against air attack. These systems should not be modeled to provide complete infallible protection but replicate systems that are based on current weapons and equipment.

After Action Review (AAR). This is a method of providing feedback to units by involving participants in the training diagnostic process in order to increase and reinforce learning.

Battlefield Effects. This term refers to a simulation's ability to replicate accurately the effects of different weapon systems, obscurants, and the fog of war.

Battlefield Operating Systems (BOS). These are the major functions occurring on the battlefield and performed by the force to successfully execute operations. These are the physical means used to accomplish the mission. These seven systems are: intelligence, maneuver, fire support, air defense, mobility/counter mobility/survivability, combat service support and command and control.

Battle Simulation Center (BSC). This is a permanent simulation center for active component divisions and corps units.

Command and Control. This BOS includes all the collective tasks associated with supporting the exercise of authority and direction by a commander over a unit. Simulations must account for the loss of visual contact or disruption of communications nets. Simulations should provide for the incorporation of friction and the fog of war. In addition, simulations should model subordinate units and leaders in a manner that provides for indecisiveness or loss of motivation. Units can be routed or prevented from acting by intense fire or confusion. A simulation should incorporate the use of military maps and icons in order to present information in a doctrinally correct setting

Command Post Exercise (CPX). This is a medium-cost, medium overhead exercise in which the forces are simulated and may be conducted from garrison locations or between participating headquarters.

Combat service support (CSS). This BOS is the system required to support the logistical needs of the unit. Simulations must not afford the unit unlimited supplies in the conduct of operations. Simulations should provide some fidelity in the expenditure of ammunition and fuel in order to properly reflect the operational reach of a unit or group of units

Decision making. FM 22-100, *Army Leadership*, defines this as the process of knowing whether to decide, then when and what to decide. It includes understanding the consequences of the decision.

Distributed Interactive Simulation (DIS). Any combination of virtual, constructive and live simulations that are distributed over a network and interact through standardized protocols.

Doctrine. The fundamental principles by which military forces guide their actions in support of objectives.

Fidelity. The degree to which aspects of the real world are represented in the model and simulation.

Fire support system. This BOS encompasses the collective and coordinated use of target-acquisition data, indirect-fire weapons and close air support. A simulation must require the correct conditions in place for the employment of fire support assets. Examples include the use of forward observers and fire support units that are within range to properly engage enemy forces. In addition, the simulation must provide and assess battle damage consistent with appropriate fire support doctrine and data.

Free play. This is the condition in a simulation whereby opposing forces are allowed to be competitive in all aspects of operations.

Intelligence system. This BOS system is the activity to generate knowledge of and products portraying the enemy and the environmental features required for a command to plan, prepare, and execute operations. Intelligence is not perfect and all knowing. Simulations must provide only a realistic amount of intelligence with regards to the enemy. One would expect to know an order of battle and to receive reports from subordinate or adjacent units but not to have a perspective on the enemy that is completely accurate.

Maneuver. The employment of forces, through movement combined with fire or fire

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potential, to achieve a position of advantage with respect to the enemy in order to accomplish a mission.

Military computer simulation. A software program or application that replicates the actions of military units in a historical based scenario or fictional scenario with the intent of replicating realistic actions and effects. This should not be confused with a "video game."

Mobility, counter mobility, and survivability systems. This BOS is normally considered engineer functions that support the friendly force freedom of maneuver, deny the enemy freedom of maneuver or provide protection to the friendly force. Simulations must account for the use of obstacles, fortifications and the effects of smoke. In addition, simulations must account for the impact of engineers during the conduct of offensive operations.

Modeling and Simulation (M & S). A model of a system is a representation of a system and a simulation is the operation or exercise of the model of the system. These terms are often used interchangeably.

Multi-echelon training. This is the simultaneous conduct of different exercises by a unit or the training of different tasks by elements of the unit. This training is present whenever collective training is conducted.

Off-the-Shelf Computer Simulations. These simulations are software that has already been developed either by civilian companies or military agencies for commercial or government use.

Opportunity Training. Training events that are pre-selected, planned and prepared for by leaders as "stand by" events. These events will be executed in the event that the training schedule of a unit changes in a manner that results in unallocated training time. This type of training is often referred to as "hip pocket" training.

Resolution. This is the degree of detail and precision used in the representation of real world aspects in the model and simulation.

Situational Training Exercise (STX). This is a mission-oriented limited exercise designed to train one collective task, or a group or related tasks or drills, through practice and repetition.

Tactics. FM 3-0, *Operations*, defines tactics as the employment of units in combat. It includes the ordered arrangement and maneuver of units in relation to each other, the terrain, and the enemy to translate potential combat power into victorious battles and engagements.

Tactical Decision-Making Exercise. This is a scenario driven event that demands a leader conduct an analysis of the situation, develop possible courses of action and make a decision. These exercises limit time for analysis and require a leader to decide and then defend his actions.

Training. It is the instruction of personnel to individually and/or collectively increase their capacity to perform specific functions and tasks.

Training Objective. This is a statement that describes the desired outcome of a training activity. It is composed of the following three parts: task, conditions, and the standards.

Training Schedule. FM 25-101 defines a training schedule as a document prepared at the company level that specifies the "who", "what", "when", "where" of training to be conducted by the unit.

Video Game. A software program that is played purely for entertainment with little application to the profession of arms.

Wargame. James F. Dunnigan provides a complete definition of a wargame. A wargame combines a map, playing pieces representing historical personages or military units and a set of rules telling you what you can or cannot do with them. This definition applies to both manual and computer wargame. The National Simulation Center further defines a wargame as a simulation (computerized or noncomputerized) involving at least two opposing forces in a military operation. Wargames employ various data, specific rules, and procedures that cause the participants to interact in a simulated or real situation.

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