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## **FY03 WARGAMING ASSESSMENT REPORT**

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**AIR FORCE RESEARCH LABORATORY**  
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## **Contents**

Abstract	iii
List of Figures and Tables	iv
<b>EXECUTIVE SUMMARY</b>	<b>1</b>
Introduction	1
Purpose of Assessment Report	1
Outline of Assessment Report	1
Definition of Wargaming	1
How Wargaming is Currently Used in the Air Force	2
Conclusion	3
<b>I. RATIONALE</b>	<b>4</b>
Introduction	4
Joint Vision 2020 Support	4
Air Force 2020 Support	5
Air Force Strategic Plan (AFSP) Volume 3 Support	5
Joint Publication 3-30 Support	5
Deficiencies	6
Customers	7
Applications	7
Conclusion	8
<b>II. FUTURE NEEDS</b>	<b>9</b>
Introduction	9
The Third Generation Wargame	9

Research and Development Requirements	11
Conclusion	11
<b>III. CAMPAIGN PLAN</b>	<b>12</b>
Introduction	12
Assessment Plan	12
Collection Plan	12
Development Plan	12
Deployment Plan	14
Conclusion	14
<b>CONCLUSION</b>	<b>15</b>
Works Consulted	16
Acronyms	17

## **Abstract**

This report documents the annual assessment component of the wargaming campaign plan of the Air Force Research Laboratory's Information Directorate's C4ISR Modeling and Simulation Branch. The purpose of this report is to communicate to the leaders in our organization the validity and goals of our research in support of superior command and control technology for the 21st century warfighter as it relates to wargaming. This document's structure is designed to be a concise representation of our rationale for pursuing this research, a description of the future needs in wargaming technology, and an explanation of our campaign plan. The intent is for this document to be augmented and republished at the conclusion of each fiscal year. As a result, we will establish both a written metric for our intended accomplishments and a statement of accountability for our progress. Moreover, it is important to understand the collection of information to develop this assessment report is a continuing process which will extend beyond this publication. As technology in general continues to evolve exponentially, advances and innovations in wargaming do so accordingly.

## **List of Figures and Tables**

Figure 1: State of Current Wargames	6
Figure 2: Third Generation Wargame Concept	10
Table 1: Customers	7
Table 2: Applications	7
Table 3: FY04 Development Plan	13
Table 4: FY05 Development Plan	13
Table 5: FY06 Development Plan	13

## **EXECUTIVE SUMMARY**

### **Introduction**

*Air Force Vision 2020* states, “Real transformation is not the result of a one-time improvement, but a sustained and determined effort.” In this era of transformation within the DoD and the Air Force, our wargames must evolve accordingly to foster not only an adequate portrayal of our doctrine and systems but our enemies’ as well. They must be adaptive, agile, and without bias. We wargame not only because it’s required by Joint Doctrine but due to its historical track record of accelerating transformation and to develop better strategies and strategists across all levels of command. Moreover, the vision of our wargames must be evolved from that of winning the war to winning the peace.

To accomplish these goals in wargaming, it will require a sustained and determined effort from key members and leaders within the DoD. It will involve seeking innovative material and non-material solutions in wargaming. It will compel the Future Total Force to reevaluate the necessity and role of wargames and access to them in educational, operational, and strategic environments. Further, it will dynamically redefine the scope of wargaming technology and its relationship with information systems. This will provide the tools and synergy required to “leverage information technology as a way to continue transforming our operational capabilities and command and control.”

### **The Purpose of this Assessment Report**

The purpose of this assessment report is to document the significance of wargaming and the efforts of the Air Force Research Laboratory’s Information Directorate’s C4ISR Modeling and Simulation Branch (AFRL/IFSB) to collaboratively research and develop enhanced wargaming technology to meet the needs of current and future warfighters.

### **Assessment Report Outline**

Chapter I will describe the rationale for wargaming. Chapter II will address the needs of future wargaming technology with respect to key areas of research and development. Chapter III will outline the Information Directorate’s campaign plan to develop wargaming technology.

### **What is Wargaming?**

According to AFI 10-233, a wargame is a simulation, by whatever means, of a military operation involving two or more opposing forces using rules, data, and procedures designed to depict an actual or assumed real-life situation. The terms modeling and simulation are sometimes used interchangeably with wargaming. Actually,



wargames are distinct from models and simulations as they include a thinking adversary, though models and simulations are often used to adjudicate wargames.

Further the Air Force Institute for Advanced Distributed Learning (AFIADL) states models and simulations support wargaming by providing:

- Tools for gaining insights into the dynamics of warfare
- A mechanism to explore feasibility and implications of plans, concepts or new technologies
- Aids to commanders and staffs in practicing decision-making under simulated battlefield conditions

Wargaming consists of two key characteristics; the first one involves the conflict of at least two active decision-makers, either human or an artificial opponent (the computer) and the second one is the modeling of a war-type conflict such as Desert Storm.

Specifically, wargames seek to create very realistic synthetic decision making environments. Wargames create synthetic versions of all elements of the decision loops, from the information available before a decision to the feedback available after. Typically several decision cycles are depicted normally using complex models, simulations and often the latest in computer technology.

### **How is Wargaming Currently Used in the Air Force?**

The Air Force uses wargames to develop strategists and develop strategies at every level of war. Air Force wargames are used by our commissioning sources, early professional military education schools and specialized courses to help their students grasp tactical strategies and to provide a foundation for further professional development. Our Intermediate Developmental opportunities and operational level courses use wargames to help their students develop as campaign planners and operational strategists. Finally our Air War College uses wargames to help their students to develop as strategists at the national level.

Wargames also help the Air Force develop, evaluate, and defend strategic level strategies. Further, Air Force wargames explore concepts, capabilities, and emerging doctrine. They study and refine emerging and future operational concepts and capabilities to promote *Air Force Vision 2020*, to evaluate the Air Force Strategic Plan, and to enhance C4ISR. The Air Force conducts several of its own strategic level wargames and participates in other Service's wargames. Air Force participation in the Army and Navy Title 10 wargames is intended to highlight how modern air and space power contributes to joint operations. Notably, participation in them explores the potential synergy of emerging Air Force, Army, and Navy concepts. In addition, there are several interagency efforts at varying classification levels that further augment and integrate the unclassified analysis. Wargame scenarios, concepts, and capabilities are

enacted in future timeframes. Moreover, all of the Air Force's Professional Military Education Schools and commissioning sources use wargaming as a means to instruct.

Recognizing the volatile environment in which today's Airmen find themselves, the Chief of Staff of the Air Force directed that a recurring Air Force wargame, *Global Engagement*, examine the comprehensive application of air and space power. It explores air and space contributions to joint warfighting 10 to 15 years in the future. *Global Engagement* seeks to examine the totality of modern warfare on a level playing field. In a structured forum, military and policy experts highlight, discuss, explore, and define warfighting concepts and issues that can shape the future Air Force.

To explore Air Force innovation 20 or more years into the future, the Air Staff utilizes the *Futures Game*. Set approximately a decade beyond *Global Engagement*, the *Futures Game* works within the context of the Administration's guidance and strategy in order to determine capabilities most able to move the Air Force towards its vision. Proponents of new concepts, capabilities, and emerging doctrine include these innovations in the wargames to evaluate their future potential and raise their visibility.

Wargames also help the Air Force develop operational and campaign level strategies. Wargaming is an integral part of both the deliberate planning and crisis action planning processes. Air Operation Center Strategy Divisions use wargames both to help examine the relative advantages of potential courses of action (COAs) and to help develop campaign plans. (Or to be precisely correct, the air element of the theater campaign.)

Wargaming is also beginning to help the Air Force develop tactical strategies. For example, there has been both an increase in the level of use and sophistication of mission rehearsal software; that is software that allows pilots to fly their missions in simulation before doing it for real. Originally envisioned as a way to help pilots learn terrain features newer mission rehearsal software is incorporating threats, becoming true wargames, allowing pilots to make fatal mistakes in the safety of the simulator. The resulting flight plans are safer and more effective.

## **Conclusion**

As outlined in the National Security Strategy of September 2002, we must "build better, more integrated intelligence capabilities to provide timely, accurate information on threats, wherever they may emerge...[and]...continue to transform our military forces to ensure our ability to conduct rapid and precise operations to achieve decisive results." Advances in wargaming technology and its merger with integrated intelligence systems will provide the means to efficiently and effectively win our nation's wars faster while improving our chances of achieving a better state of peace – the real reason we fight in the first place.

## **I. Rationale**

### **Introduction**

Wargaming has a historic track record for accelerating transformation and developing better strategists and strategies. Moreover, wargames permit us to analyze the impact of a thinking adversary while pure models and simulations do not. As President Bush noted in the National Security Strategy (NSS) of September 2002, “In the new world we have entered, the only path to peace and security is the path of action...[we must]...continue to transform our military forces to ensure our ability to conduct rapid and precise operations to achieve decisive results.” Wargames allow us to test and evaluate new doctrine, tactics, and strategies without the cost of life and resources. In doing so, wargames provide valuable analysis to ensure our courses of action cause the desired effects we seek to achieve at a cost we can afford – both militarily and politically.

### **Joint Vision 2020 Support**

The pursuit of wargaming technology supports *Joint Vision 2020* in four key areas: Full Spectrum Dominance, Information Superiority, Innovation, and Interoperability.

Full Spectrum Dominance is defined as “the ability of US forces, operating unilaterally or in combination with multinational and interagency partners, to defeat any adversary and control any situation across the full range of military operations.” Advanced wargaming technology will enable full spectrum dominance by training US forces to conduct “prompt, sustained, and synchronized operations.” Wargames will continue to demonstrate how U.S. and allied forces can execute their campaign plans seamlessly.

Information Superiority is defined as “the capability to collect, process, and disseminate an uninterrupted flow of information, while exploiting or denying an adversary’s ability to do the same.” Additionally *Joint Vision 2020* notes, “Throughout military history, military leaders have regarded information superiority as a key enabler of victory.” We exist in an age where the amount of information available during a campaign is too vast for any military entity to fully process and evaluate it. Moreover, “...advances in information capabilities are proceeding so rapidly that there is a risk of outstripping our ability to capture ideas, formulate operational concepts, and develop the capacity to assess results.” As the Air Force adapts to this new theater of operations, it is imperative we develop tools to assist key decision makers. To do this, we must develop wargaming toolsets which execute, evaluate, and provide guidance concerning intended COAs. In doing so, we will provide one opportunity for the achievement of decision superiority.

Wargaming supports the concept of innovation within the joint force because it provides “...a means of interaction and exchange that evaluates goals, operational lessons, exercises, experiments, and simulations.” Further, wargames foster new ideas and critical thinking necessary and serve as a means for feedback as well.

Finally, wargaming enhances interoperability within the joint force by providing the means to create an “...adaptive organizational structure that will allow trained and experienced people to develop compatible processes and procedure, engage in collaborative planning, and adapt as necessary to specific crisis situations.” Wargames will continue to encourage teambuilding and mutual understanding of each service’s distinctive capabilities with each other.

### **Air Force 2020 Support**

Enhanced wargaming technology and methods will advance the command of air and space power by revealing how to best integrate systems to produce the desired effects the nation needs. The execution of wargames during campaigns will facilitate the Air Operations Center’s (AOC) ability to “...gather and fuse the full range of information, from national to tactical, in real-time, and to rapidly convert that information to knowledge and understanding—to assure decision dominance over adversaries.” By doing so, “we will leverage information technology as a way to continue transforming our operational capabilities and command and control.” Wargaming will assist the Joint Force Air Component Commander (JFACC) by providing potential insight on leverage points during a campaign’s execution. Moreover, wargaming will permit the Air Force to remain agile while not degrading the synergy produced during the execution of air and space power.

### **Air Force Strategic Plan (AFSP) Volume 3 Support**

Volume 3 of the AFSP clearly supports advancement in wargaming. For example, the document states that Critical Future Capabilities “...provide strategic focus to simulation and wargaming efforts including Global Engagement, Aerospace Future Capabilities Game, and the Joint Expeditionary Force Experiment (JEFX) efforts.” Thus, wargaming efforts are a key component to air and space technology development and deployment. AFSP further supports this claim by stating “U.S. superiority in Innovation and Science and Technology (S&T) will continue as a cornerstone of our national military strategy. In support of this strategy, the Air Force remains committed to leading the way, using a vigorous program of research, experimentation, gaming, testing, exercising, and evaluating new aerospace operational concepts and system.” Clearly, wargaming is a critical component enabling future capabilities.

### **Joint Publication (JP) 3-30 Command and Control of Joint Air Operations Support**

The new JP 3-30 states, “c. Phase 3 COA Analysis, (1) COA analysis involves wargaming each COA against the adversary’s most likely and most dangerous COAs. (page III-13) In so doing JP 3-30 brings the procedures for the planning of air operations in line with the procedures long used for planning ground, naval and Joint Forces operations.

## Deficiencies

Many deficiencies exist in modern wargames. Most importantly, very few strategic level wargames exist and those that do are inadequate for today's requirements. Further, U.S. and adversarial doctrine is evolving away from the type of conflict best exhibited through attrition wargames. Nevertheless, we are still aggregating attrition-based models from tactical level wargames to those which represent operational and strategic level combat (see Figure 1). For this reason, using attrition models to combat asymmetric threats will result in the lengthening of our decision process. Finally, many educational models are too cumbersome and are not used in potential applications. The following tables represent many of our potential customers and applications to be developed for them.

**Figure 1: State of Current Wargames**



**Table 1: Customers**

	<b>Military Education</b>	<b>Planning and Ops</b>
<b>Military Strategic</b>	Air War College National Defense University Army War College Naval War College	Office of Net Assessment Air Force Studies and Analysis Joint Staff/J-8 Title X & Tech Games
<b>Campaign Operations</b>	Air Command & Staff College Joint Forces Staff College Command and General Staff College USMC Staff College	AF/XOOC (Checkmate) AOC Strategy Divisions Crisis Action Planning Teams Deliberate Planning Cells
<b>High Tactical</b>	Squadron Officers College Air Force (and other) Academy AF (and other) ROTC Officer Training/Candidate School	Wing Operations Center Squadron Operations Center Base Security Force CP Air Base CP

**Table 2: Applications**

	<b>Military Education</b>	<b>Planning and Ops</b>
<b>Military Strategic</b>	Apply all elements of national power to resolve crisis/conflict  Understand long term impacts of budget decisions	Forecast impact of all elements of national power on crisis/conflict  Understand long term impacts of budget & tech decisions
<b>Campaign Operations</b>	Apply service and Joint military power to achieve campaign end state  Better understand historical campaigns	Develop and compare Courses of Action (COA) in both the Crisis action  Planning (CAP) and  Deliberate Planning environments  Evaluate individual ATOs
<b>High Tactical</b>	Employ all aircraft types to achieve synergistic effects  Apply combined arms and joint concepts  Understand air base ops	Plan aircraft routes/packages  Develop plan to maximize sortie generation in hostile environment  Develop plan to defend base  Plan service and joint battles

## **Conclusion**

The documents highlighted above make a clear case for continued wargaming technology development. Future wargames will deliver to a commander a clear evaluation of an intended COA as well as suggestions for improvement. All of these documents have stated in one form or another decisive, real-time execution of air and space power is essential for future operations to be successful. Wargaming will continue to be a unifying platform to ensure we win our nation's wars.

## **II. Future Needs**

### **Introduction**

“The enemy we're fighting is different from the one we'd war-gamed against.” Those words, quoted from Lt Gen William Wallace, Commander of the US Army's V Corps during Operation Iraqi Freedom, suggests both the importance and the fallibility of wargaming within the DoD today. In this era of effects-based operations (EBO) and transformation, our wargames must evolve accordingly to foster not only an adequate portrayal of our doctrine and systems but our enemies' as well. They must be adaptive, agile, and without bias. We wargame not only because it's required by Joint Doctrine but due to its historical track record of accelerating transformation and to develop better strategies and strategists. Moreover, the vision of our wargames must be evolved from that of winning the war to winning the peace.

### **The Third Generation Wargame**

To accomplish these goals, we're pursuing the development of the next generation of wargames: The 3<sup>rd</sup> Generation Wargame (3GWG). 3GWG augments 2<sup>nd</sup> Generation Wargames, which model attrition, movement and logistics, by additionally incorporating three crucial thrusts: Decision Cycles, Human Factors, and System Effects.

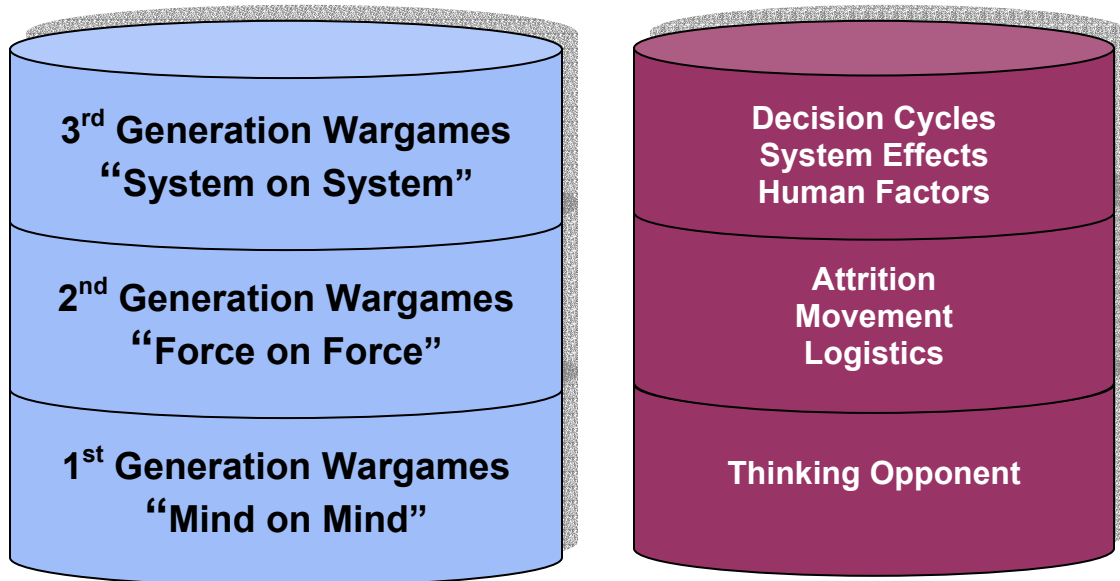
First, a decision cycle is the amount of time an entity takes to make a decision based upon the scope of its responsibilities, its current physical and physiological state, and the quantity and quality of information it receives. Normally, decision cycle lengths are directly proportional to the level of warfare in which an entity is placed. An entity at the tactical level of war will normally have a shorter decision cycle than an entity at the strategic level. This is because the breadth and depth of information with respect to dynamic system effects at the tactical level is less than that at the strategic echelon. Further, decision cycles of entities at the tactical level influence those at the operational level and so on. An entity's decision cycle also tends to be influenced by its state, with healthy, calm entities reacting faster than ones that have taken battle damage and are approaching the limit of their psychological endurance. The quality of incoming information also has an impact. Determining the quality of information involves examining the uncertainty and incompleteness associated with it.

Next, human factors help determine the effectiveness of the entities depicted. Its adjudication includes, but isn't limited to: morale, training, maintenance efficiency, social-economic factors, suppression (physical and psychological), C4ISR, and media influence applied to an entity. These “soft” factors have historically had a significant influence on the outcomes of wars and failures to model them have misled decision makers. For instance, during Operation Desert Storm wargames depicted Iraqi forces fighting to the last soldier. This resulted in unbalanced logistics, ill-equipped means to handle Iraqi prisoners of war, and may have influenced planning for the war's end state.



Finally, it is vitally important that we anticipate the system effects of our actions. The 2003 Northeast Blackout illustrated how the failure of a component can have cascading effects throughout a large system. Modeling not only the immediate physical effects of our actions will allow us to pick targets more likely to achieve our objectives sooner and it will help us avoid unwanted “collateral system effects” as well. Doing so is not some far off dream. The modeling of cascading effects within a single system has been possible for decades and there have been recent advances in modeling effects across systems and modeling huge systems in a reasonable amount of computer time.

**Figure 2: Third Generation Wargame Concept**



The Third Generation Wargame will be able to provide commanders with a prompt, sustained, and accurate assessment of their campaign plans before, during, and after combat operations. This technology will be the cornerstone for intelligent toolsets and applications to aid in achieving full spectrum dominance by reducing the warfighter’s decision cycle.

Further, the Third Generation Wargame isn’t one system or one piece of software which will solve all DoD wargaming deficiencies. Instead, it should be viewed as an architecture designed to guide each component of the DoD to develop wargames that reflect and enhance their distinctive capabilities in a manner which truly reflects the way we fight our nations wars today and our joint doctrine and vision shared for the Future Total Force. As this architecture is defined over the next several months and validated during the next few years with our sister services, we hope to foster new innovations in joint doctrine and interoperability within the DoD.

## **Research and Development Requirements**

There are many areas of research and development applicable to the 3GWG. While others will emerge over time, some of the major research topics include:

- Develop toolsets to relate psychological, behavioral, and system effects.
- Develop algorithms to properly assess system effects.
- Develop an efficient, easy to learn interface.
- Assess current order of battle algorithms.
- Foster joint 3GWG architecture.
- Create variable decision cycle models.

## **Conclusion**

Our ultimate success will require not only making progress in modeling decision cycles, humans factors, and physical effects but in integrating these capabilities with traditional attrition models. Third Generation Wargames will help us to educate superior decision makers by assisting them in making better decisions. Additionally, there is a large amount of research to be done. This shouldn't be performed by one organization or one service. The development of the Third Generation Wargame must be a cooperative effort.

### **III. Campaign Plan**

#### **Introduction**

The end state of our campaign is for U.S., allied forces, and friendly states to enjoy a decisive “decision superiority” over adversaries through the use of improved wargames. This effort will involve collaboration with several Air Force, Joint, and commercial, and possibly international partners. Over the next year, we will be seeking to further identify key partners and establish productive relationships with them to foster innovative research and quality products for the warfighter.

#### **Assessment Plan**

This report is the embodiment of the assessment plan. We will review and update this report on an annual basis to document our progress. The assessment plan will hold this effort accountable to its objective.

#### **Collection Plan**

The collection plan will be an ongoing process to accumulate and assimilate current efforts across the DoD, commercial, and international wargaming communities. We are actively engaging in this plan in order to comprehend our competition, avoid duplicating efforts, to strengthen our case within the Air Force, and to identify new partners and customers. Our course of action for implementing this plan includes identifying the major contributors to wargaming technology, both friendly and adversary sources, attending wargaming conference throughout the year, and constructing a website in order to create a venue to report and foster new innovations.

#### **Development Plan**

The development plan is an outline for projects and milestones AFRL/IFSB intends to execute or achieve in the near term. These projects represent realistic objectives and not idealistic aspirations. As this program establishes itself over the next few years, the list of objectives is expected to increase. Our goal is to design our program with the intent of delivering the most advanced wargaming technology to the warfighter as rapidly as possible.

**Table 3: FY04 Development Plan**

<b>Project</b>	<b>Purpose</b>
Draft 3GWG Specification	Formally define the metrics of a 3GWG
Initial 3GWG Joint Working Group Meetings	Foster joint contribution and evaluation of the 3GWG concept
Decision Cycle Analysis Tool (DCAT)	Evaluate the design and feasibility of a decision cycle toolkit
SimBionic SBIR Upgrades	Enhance AI authoring toolkit abilities for intended integration with 3GWG architecture and DCAT toolkit
WARCON SBIR	Toolkit for “quick fixes” to current wargames
Local Wargaming Professional Development	Promote the interest and understanding of wargames to develop airmen within the Information Directorate

**Table 4: FY05 Development Plan**

<b>Project</b>	<b>Purpose</b>
3GWG Specification Release (for comment)	Formally announce the metrics of a 3GWG for feedback from specific sections of DoD community
3GWG Joint Working Group Meetings	Continue fostering joint contribution and evaluation of the 3GWG concept
DCAT Upgrade	Improve decision cycle toolkit
Host Connections 2005	Increase the defense utility of all conflict simulations by facilitating their evolution toward greater comprehensiveness and accessibility
WARCON SBIR Release	Toolkit for “quick fixes” to current wargames
Local Wargaming Professional Development	Promote the interest and understanding of wargames to develop airmen within the Information Directorate
EBO Wargame Interface Development	Improve educational wargames by reducing awkward interface and permitting the full implementation of EBO

**Table 5: FY06 Development Plan**

<b>Project</b>	<b>Purpose</b>
3GWG Specification Full Release	Formally announce the metrics of a 3GWG to the DoD community
3GWG Joint Working Group Meetings	Continue fostering joint contribution and evaluation of the 3GWG concept
SimBionic and DCAT Software Integration	Provide a more robust wargaming toolkit which merges decision cycle theory and AI behaviors
Local Wargaming Professional Development	Promote the interest and understanding of wargames to develop airmen within the Information Directorate
EBO Wargame Interface Demonstration	Improve educational wargames reducing awkward interface and permitting the full implementation of EBO

## **Deployment Plan**

In order to establish ourselves and deliver our products to the warfighter, we will pursue an active deployment plan. We intend to write articles to various DoD publications, attend several yearly wargaming and strategy conferences, and launch a comprehensive website to serve as a source for both the accumulation and dissemination of wargaming information.

## **Conclusion**

We will implement this campaign plan to ensure all of our actions contribute to our end state. We realize, though, no plan fully survives execution. For this reason, we have included an annual assessment plan as part of our overall strategy to ensure we continue to pursue the correct technology and research for this effort. This will achieve our goal of increasing U.S. military effectiveness by developing more effective strategists and strategies at all levels of command through the research, development and deployment of more effective and efficient wargames.

## CONCLUSION

Wargaming continues to be a vital component to military planning. Likewise, wargaming will remain important to future military campaigns across the full spectrum of military operations. As our methods and doctrine evolve, our wargames must do so accordingly. This report has made clear the support for wargaming across the DoD and the need for investment in wargaming technology. Our campaign planners cannot effectively prepare to execute modern doctrine and strategy on antiquated wargaming platforms. The next generation of wargames will educate leaders of air, space, land and sea power how to effectively employ and combat asymmetric warfare.

The task we are pursuing cannot be done alone. It will require a cooperative effort from our sister services, allies, and innovations within the military and commercial gaming industry. Together, we can develop the tools necessary to achieve decision superiority and maintain our advantage over our adversaries.

Wargames alone cannot fully prepare a military force for combat or predict every enemy action. They can, however, produce quality leaders trained to be adaptable to emerging threats and situations. Pursuing advancements in wargaming technology will ensure the next generation of military leaders is prepared to defend our nation – faster, at a lower cost, and with fewer casualties. Likewise, we'll improve our chances of achieving a better state of peace – the real reason we fight in the first place.

## **WORKS CONSULTED**

Air Force Strategic Plan Volume 3, February 1999.

Air Force Vision 2020, June 2000.

Joint Publication 3-30 Command and Control of Joint Air Operations, June 2003.

Joint Vision 2020, June 2000.

The National Security Strategy of the United States of America, September 2002.

## ACRONYMS

3GWG	Third Generation Wargame
AFI	Air Force Instruction
AFIADL	Air Force Institute for Advanced Distributed Learning
AFRL	Air Force Research Laboratory
AFSP	Air Force Strategic Plan
AOC	Air Operations Center
C4ISR	Command Control Communications Computers Intelligence Surveillance Reconnaissance
COA	Course of Action
DCAT	Decision Cycle Analysis Toolkit
DoD	Department of Defense
EBO	Effects Based Operation
IFSB	AFRL's Information Directorate, C4ISR Modeling and Simulation Branch
JEFX	Joint Expeditionary Force Experiment
JFACC	Joint Force Air Component Commander
NSS	National Security Strategy
Ops	Operations
SBIR	Small Business Innovative Research
S&T	Science and Technology