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Wargaming for the RAAF

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PREFACE

'Compared to war, all other forms of human endeavour pale into insignificance.....'
George S. Patton Jnr,
General, US Army, 1944

History has shown that numerical superiority, better equipment and greater resources do not guarantee victory, which has often gone to the smaller but better prepared and led force. Successful commanders have always recognised the crucial impact of the human factor on war and have conducted their campaigns accordingly. The outcome of battle is rarely certain, because human behaviour cannot be predicted with certainty.

In addition to the classic military virtues (morale, esprit d'corps, tenacity and dedication), the outcome of battle hinges on the decision making of the leaders, from junior NCO level upwards, both before and during combat. The principal advantage of wargaming is that it enables us to explore the impact of the human factor (especially decision making and associated staff procedures and planning) on the dynamics of war without the massive expense of large scale exercises.

Wargaming is basically the simulation of war, in all its facets. Of course, there is more to modern war than combat War in the computer age includes everything from industrial mobilisation to combat logistics. Wargaming can simulate the full range of operational aspects of war (in air warfare this means prosecuting the three campaigns - control of the air, bombardment and support for combat forces) and the sustainment aspects of war (including command, control, communications, intelligence, training and logistics).

Wargaming will never 'prove' anything or predict an outcome with certainty. It is merely a means of studying a problem and highlighting or exploring important issues. It will never be a substitute for actual operational experience.

Even though Australia's military posture is totally defensive, we must train and prepare for war. Only by reaching

and demonstrating adequate standards of capability to wage war, can we deter potential aggressors and obviate the need to fight. For generations, wargaming has been used extensively by the armed services of many nations to study and prepare for war.

The most effective and efficient military organisations of modern history (eg: the Prussian/German Army) have valued wargaming very highly and used it extensively. Some of the greatest victories of the century (eg: the German conquests in 1939/41 and the Japanese Pacific campaign in 1941/2) were partly facilitated by the effective use of wargaming. This thesis will demonstrate the potential of wargaming by examining the history of the art.

The ADF, particularly the RAAF, made no use of wargaming until very recently and we still have exploited only a fraction of its potential. In approving wargaming as the topic of study for the first Air Power Studies Centre fellowship (in 1990), CAS both recognised and addressed that shortcoming.

Before the RAAF can realise the potential of wargaming, we must have a clear understanding of what wargaming is and is not. This thesis will explain the nature of wargaming, as a methodolgy for studying and preparing for war. It will also describe the essential characteristics of wargaming.

The applications of most relevance and benefit to the RAAF, in the short and longer terms, are explained. Wargaming is shown to be a cost effective alternative and/or supplement to exercises. Sometimes it is the only way to achieve an objective in periods of peace and financial constraint.

Wargaming is a technique that is unfamiliar to most members of the RAAF. Some previous attempts at wargaming have foundered, as a result of lack of experience, a haphazard approach or lack of perseverence in the face of apparently insurmountable difficulties and a perceived lack of interest. This thesis proposes a systematic approach to wargame development and implementation, that will hopefully minimise the difficulties and maximise the benefits of wargaming in the RAAF.

Finally, the current 'state of the art' of wargaming is explained. Sources of wargaming advice and assistance are listed and a representative cross section of air power oriented wargames are described. The possible future of wargaming is also touched on.

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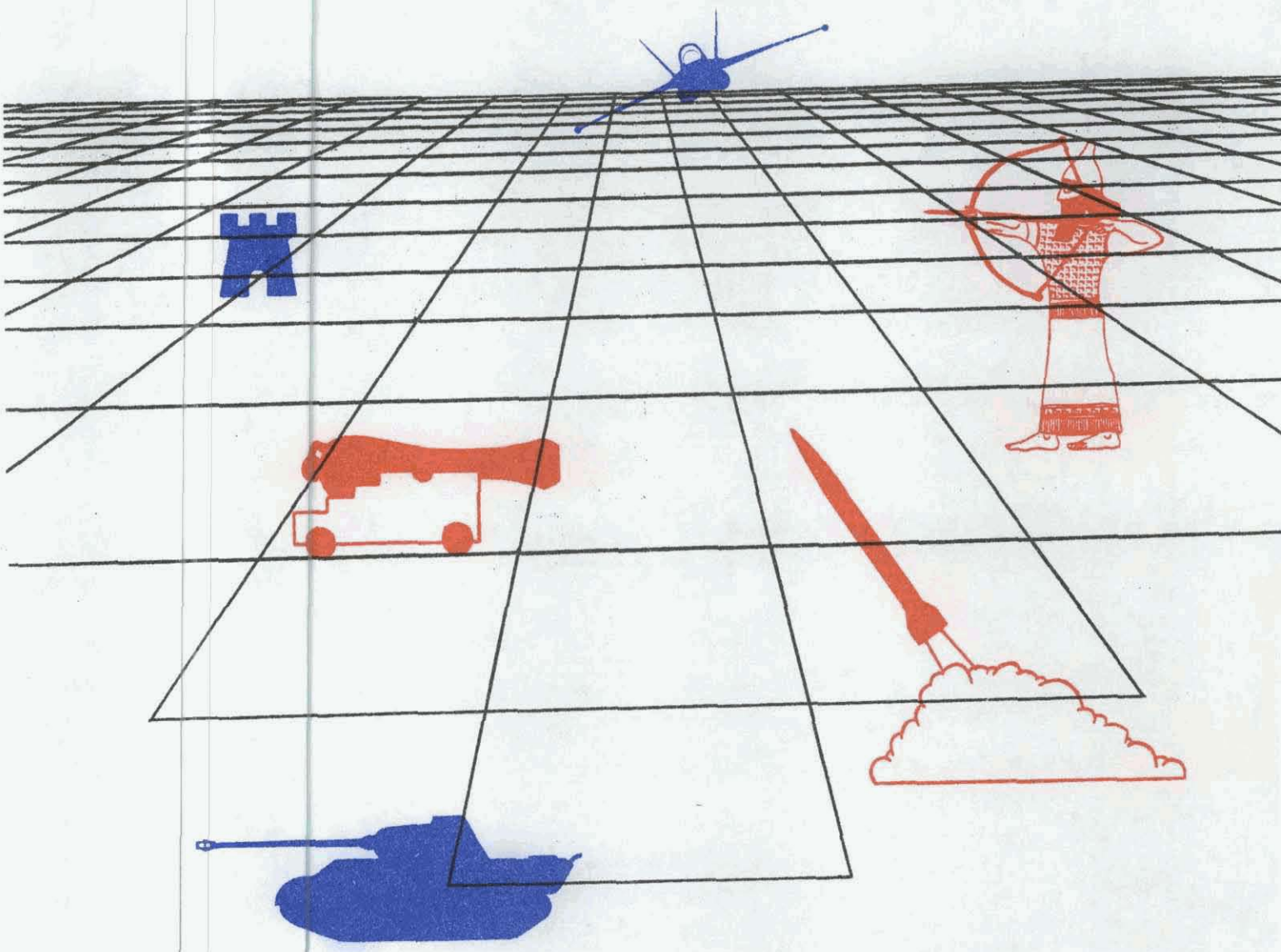
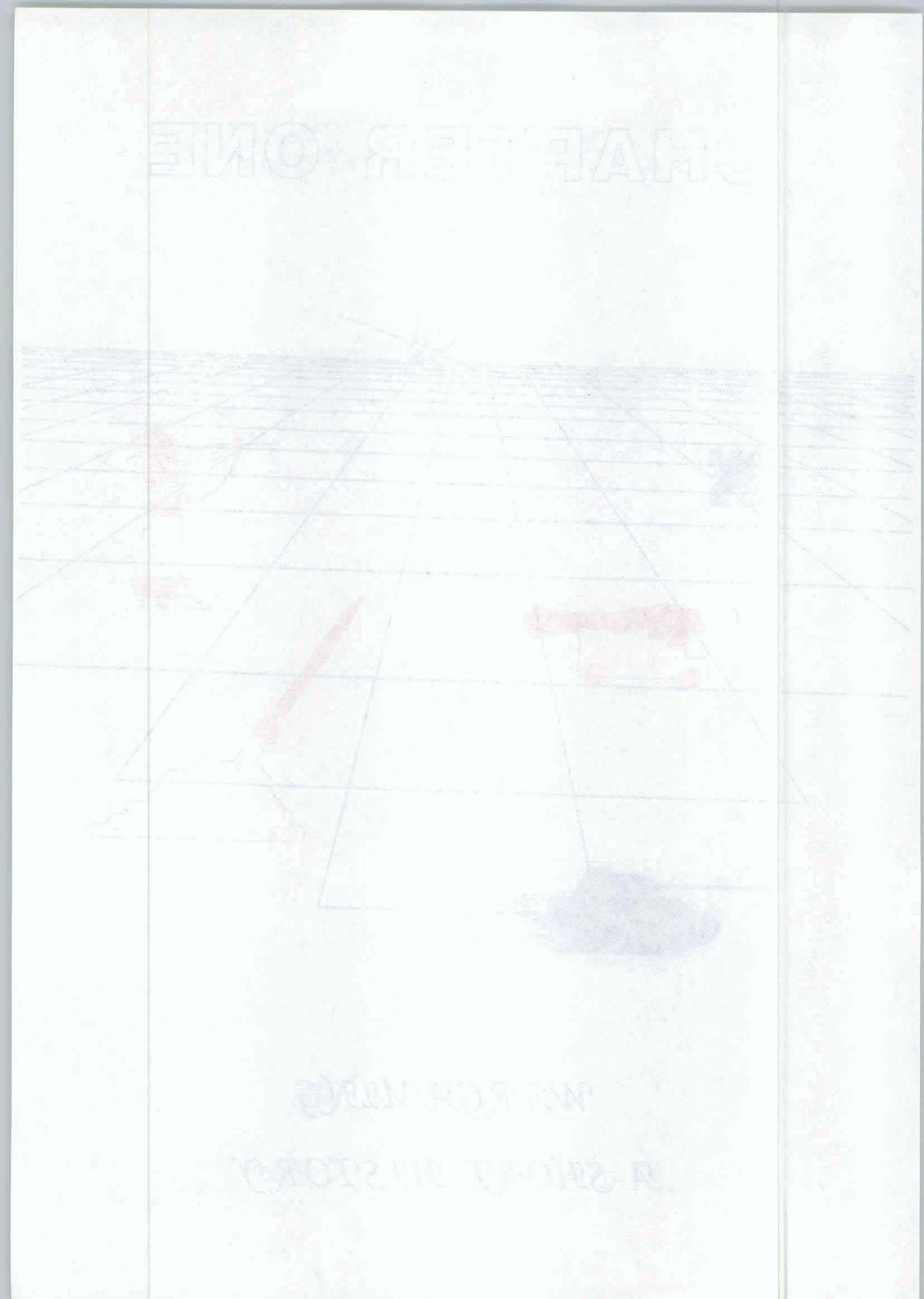
CHAPTER ONE



WARGAMING

A SHORT HISTORY



A SHORT HISTORY OF WARGAMING

'This is not a game at all. This is training for war.'
Field Marshal Baron Karl von Muffling
Chief of the General Staff
Prussian Army 1821.

INTRODUCTION

Simple, abstract war games have been played by men of all ages for thousands of years. Until the 19th century the games were little more than variations of children's toy soldiers. They were just entertainment. This chapter describes the development of wargaming; the military application of war games.

THE EARLY YEARS

As early as 3,000 BC, the Chinese were playing a game of manoeuvre with coloured stones that could be seen as the archetypal wargame. Some historians credit the celebrated general and military philosopher Sun Tzu with the invention. Later, the Hindus played a chesslike game, in which the playing pieces represented infantry, archers, cavalry and elephants.[1] These early abstract games helped train minds to think logically, but had little direct military application. They lacked any representation of terrain or combat resolution model, beyond the simple exchange of pieces, as in chess. They eventually evolved into modern chess and checkers.

By the 18th century, complex adaptations of chess had appeared in Europe and were very popular among the junior officer corps of most European armies. These 'war chess' games were played on elaborate multi-coloured boards, with up to 3,600 squares, which were an abstract representation of terrain. The playing pieces represented the main arms and services of armies of the period, but were still moved in the stylised chess manner.

A typical example of 18th century 'war chess' was a version designed by the Master of Pages at the Court of the Duke of Brunswick and first played in 1780. There were 120 playing pieces, representing the principal combat arms (infantry, cavalry and artillery), with different degrees of mobility, expressed as movement allowances (in squares per turn). There were also methods of representing forts, trenches and pontoon bridges. The playing surface consisted of 1,666 squares, each coloured to indicate terrain, including red (mountains), blue (rivers and lakes), light green (swamp), dark green (forest), pink (towns and villages) and white (open terrain). The game was controlled by an umpire, who decided the outcomes of engagements subjectively. There was still no practical application, merely mental stimulation.[2]

One of the most unusual games of the period was a naval manoeuvering game created by a Scotsman who had never even been to sea. The game was published in the early 1780s and two of the great British admirals of the period (Nelson and Rodney) actually credited the game with inspiring some of the tactics that they used successfully against the French fleet. The game used tiny scale models (miniatures) of warships and movement was free of chess square restrictions, as any flat, featureless surface is a suitable simulation of the open ocean. However, the game was really just an abstract simulation of sail ship movement and lacked any realistic combat resolution model.[3]

THE MODERN AGE - BEFORE HIROSHIMA

The Prussians

As with so many 19th century military innovations, it was the Prussians who made the breakthrough that led to practical military applications of gaming. In the early 1800s, a small group of Prussian junior officers, perhaps inspired by the knowledge that Napoleon had used coloured pins on maps to plan his campaigns, increased the realism of their chess-based game by changing the playing surface from a chess board, first to a sand box and then to standard army tactical maps. The red (enemy - nothing to do with communism) and blue (friendly) playing pieces were cut to the shape and size (scaled to the map) of standard field formations such as cavalry squadrons, infantry battalions and artillery batteries. A set of dice was used to simulate the 'fortunes of war', complex tables were used to resolve combat and an umpire controlled the game play, as objectively as possible. Thus was born 'Kriegsspiel' (wargame).[4]

When the Chief of the Prussian General Staff saw Kriegsspiel being played, he is said to have exclaimed:

> *'This is not a game at all!*
> *This is training for war!*
> *I must recommend it to the whole army!'*[5]

The use of Kriegsspiel spread throughout the army. The first formal wargame manual was produced in 1824. Kriegsspiel was basically what is now called a Command Post Exercise (CPX) or staff procedural trainer. It was a means of giving corps and divisional commanders and their staff officers the opportunity to deal with realistic combat situations, during the winter months, in preparation for the annual summer manoeuvres.[6]

The concept was also adopted by the Prussian General Staff, which evolved a second application for Kriegsspiel. They used it as a planning tool. Mobilisation plans, strategy, tactics, logistics arrangements and all other operational aspects of their plans were practised on the wargaming table. Plans were thus refined and purged of many flaws before being implemented on European battlefields. Today we would call this application Headquarters gaming.[7]

The amazingly quick, decisive victories won by the Prussian Army in the 1860s and 1870s were in small part due to the fact that those campaigns had been practised and refined at all levels in the army, through the medium of Kriegsspiel. Every officer had practised his part in the campaign and understood its place in the overall scheme. If any part of a plan went awry, the junior leader on the spot could use his initiative, within the framework of the overall plan, and restore the situation.

European Proliferation

Prussian successes led to a worldwide surge of interest in wargaming, in both professional military circles and among the broader civilian community. In 1875, the Russian Army adopted wargaming as a planning and training tool.[8] In 1878, a wargame was published by a Royal Navy officer. It elicited French and Italian interest. In 1883, the Chief of Staff of the British Army introduced wargaming to his organisation, which published an official wargaming manual in 1895.[9] In 1913, H.G.Wells published Little Wars, which included a simple wargame, using miniature (toy) soldiers and cannon. The book/game was very popular and remains in print today.[10]

The Germans

The German Army was modelled closely on its successful Prussian precursor. Variations of Kriegsspiel were used at all levels. The great (almost decisive) opening campaign of World War One, the German invasion of France in 1914, had been the subject of extensive wargaming. The German failure in 1914, with all its tragic consequences, was due to the failure of the field armies to stick to an optimistic timetable evolved through the traditional process of gaming and planning. The product of that process, the Schlieffen Plan, had never effectively addressed some of the crucial problems frequently raised in the pre-war wargames.[11]

When the Germans invaded France again in 1940, their campaign plan had again been refined on the wargaming table. The original plan had been an unimaginative, conservative rehash of the Schlieffen Plan, which was exactly what the French and British expected. A series of wargames conducted over the winter of 1939/40 cast serious doubt on the chances of the plan succeeding and convinced the German High Command that an alternate plan, proposed by General von Manstein, had more chance of success.[12] Von Manstein proposed a deep thrust by the Panzer divisions, concentrated at an unexpected point, with close support from the Luftwaffe. The panzers stuck to the timetable and won a very quick, cheap victory.[13]

The German failure in the Battle of Britain sheds further light on the validity of wargaming. In the process of evolving their air power doctrine in the mid 1930s, the Luftwaffe High Command (all former Army officers) had naturally used wargaming as a tool. Their wargaming had convinced them that a strategic bombing campaign was beyond Germany's resources and unlikely to defeat Britain quickly.[14] As a result of this and other factors, the Luftwaffe became a tactical air force, in terms of doctrine,

training and equipment. When Hitler and Goering unexpectedly committed it to the Battle of Britain, there was no time to evolve a strategy (or force structure, or doctrine) by the normal process of gaming/planning. The Luftwaffe campaign was hastily thrown together, lacked the coherence and precision of Army campaigns and failed, as the pre-war wargames had suggested.

The German Navy also used wargaming, in its long range war planning. In 1938, Captain (later Grand Admiral) Doenitz conducted a series of wargames to study U-boat operations against Britain in the imminent war. Doenitz used wargaming to refine his ideas, which helped him to develop force level requirements, command and control arrangements, campaign strategy and tactics for his U-boats.[15]

The United States

The US Army did not use wargaming as extensively as the German Army, restricting its use to education and training applications. The US Navy has used wargaming extensively.

The US Naval War College training programme has included wargaming since 1887. From 1913, wargames were included in the fleet's annual training process. After World War One, the most likely enemy of the US in a future war was assumed to be Japan and naval war planning centred on a Pacific war. In 1920, the US plan was for a short war (a few months) culminating in a decisive full scale fleet action on the high seas (a Pacific Jutland).[16]

The annual fleet exercises and associated wargaming each year led to a gradual evolution of the strategy, much in the Prusso-German manner. By the late 1930s, the original plan had been invalidated and a long war was anticipated. The US Navy and the US Marine Corps were trained and equipped for a series of limited fleet actions and amphibious operations, the objective of which would be to secure a chain of air, naval and logistics bases across the Pacific, wearing down Japanese air and sea power in the process. This would facilitate a naval blockade and a strategic bombing campaign (from island bases near Japan) and pave the way for the decisive act - the invasion and subjugation of Japan.[17] The long range planning and preparations (facilitated by wargaming) enabled the US to recover from the early setbacks in the Pacific and initiate successful offensive operations only months after Pearl Harbour.

The Pacific war followed the anticipated pattern. In a lecture in 1960, Admiral Nimitz (US CINCPAC in that war) said:

> *'The war with Japan had been re-enacted in the game rooms of the War College by so many people, and in so many different ways, that nothing that happened during the war was a surprise - absolutely nothing except the Kamikaze tactics towards the end of the war; we had not visualised these.'*

The war with Japan was wargamed over 300 times! The wargaming had even raised the possibility of a surprise attack by Japanese carrier-based aircraft on the US Pacific Fleet base.[18]

Japan

The Japanese Navy regularly used wargaming as a tool, to refine strategy and operational plans. The attack on Pearl Harbour and subsequent operations in South East Asia and the South West Pacific were extensively wargamed in 1941.[19]

Prior to the decisive battle at Midway, wargaming conducted at Japanese Fleet Headquarters had raised a disturbingly strong possibility that Japan might lose some of its vital and irreplaceable heavy aircraft carriers.[20] The Japanese ignored the results, implemented the plan and lost the battle, four heavy aircraft carriers, naval superiority in the Pacific and consequently the war.

WARGAMING IN THE NUCLEAR AGE THE UNITED STATES

Strategic Wargaming

The loss of the monopoly on nuclear weapons impacted decisively on US national security policy. The strategic emphasis was shifted from war fighting to war prevention. Deterrence became the primary aim and nuclear warfare became the obsession.

The US had emerged from World War Two with the unfamiliar status of 'superpower'. Unlike their British and French counterparts, US political and military leaders were not well-practised in global (imperial) strategic thinking. Aware of their limitations, they enthusiastically embraced any technique that might assist in the process of formulating doctrine, strategy and policy or provide non-lethal practice in crisis management and decision-making. Wargaming appeared to be a promising tool.

Previous US wargaming had been entirely military and mostly operational or tactical in nature. The human factor (political, social and psychological factors) had always either been ignored or treated very superficially and abstractly.[21] In the early 1950s, the Americans began integrating the human dimension into their wargaming, to broaden their simulation of the real world. This form of wargaming is now known as the Free Form or Military/Political (Mil/Pol) game.[22]

Such wargaming techniques were used in the many studies of the strategic (nuclear) balance that were conducted by a plethora of interagency working groups and committees. President Eisenhower was among those who began to have doubts about the utility of wargaming. There was widespread concern about problems with scenario definition and calculation methodology. In 1959, an expert panel was commissioned to study whether wargaming should be dropped altogether. The panel found that wargaming was indeed getting out of control, but that it was also a very useful tool, so they recommended that gaming procedures should be regularised and that gaming should continue.[23]

In 1961, the US Joint Chiefs of Staff (JCS) formed a

group tasked with creating a unified theory of military wargaming. The group evolved, under many titles, and has since performed the following functions:

a. monitor all simulations used in the US military,

b. manage externally contracted gaming programmes,

c. maintain a catalogue of wargames and military simulation models,

d. perform systems analysis for the JCS, and

e. conduct some wargaming of its own for the military and for civilian (political) leaders.[24]

President Kennedy's Secretary of Defense (McNamara) and his corporate management-oriented civilian 'whizz kids' considered the wargaming of the period to be too subjective and imprecise. Their emphasis was on the scientific approach, operations research and analysis (analysis for short). They sought an objective 'rational' basis for national policy, using increasingly complex mathematical models and computer simulations. Subjective social, political, and psychological factors were again glossed over.[25]

As the war in Vietnam escalated, the Pentagon became obsessed with computer analysis. Unfortunately, it was the wrong tool for exploring the dynamics of guerilla warfare. The analysts' 'predictions' became increasingly divergent from events on the battlefield. A rueful observation on the invalid rationalisation of which the computer analysts were guilty was that they worked on the principle that: 'my wife is not trying to kill me; therefore she loves me!'

The war in Vietnam proved to be notoriously difficult to model, in part because of a perennial problem in wargaming - how to 'think red' (red being the enemy in a wargame).[26] The Prussians had fought fellow Europeans, with similar cultural roots, military institutions and traditions, so they found it relatively easy to anticipate their enemies' behaviour. In the World Wars, the Americans also had much in common with their enemies (even the Japanese), in terms of doctrine, equipment and logistics requirements.

In Vietnam, the enemy was 'alien', the warfare 'irregular' and the terrain unsuited to high technology weaponry. The traditional conventional conflict models failed to simulate guerilla warfare in the Asian jungle. The analysts designing the models and the soldiers playing the wargames were unable to 'think red', so the results of the wargaming were of little use.

The overall failure in Vietnam led to many techniques, including wargaming, being brought into disrepute by association. By the early 1970s, interest in wargaming as a tool for doctrine, strategy and policy formulation had reached low ebb.[27]

The problem of 'thinking red' was eventually solved, to

the extent possible. The US armed forces formed special units which were provided with equipment and training as close as possible to that of the anticipated enemy (the Soviets). Teams of intelligence experts (from the CIA, DIA, NSA, etc), specialists in enemy doctrine and practice, were formed to play the enemy in major Pentagon and War College wargames.

The validity of these measures depends heavily on a factor that does not apply in Australia's case. This is the existence of one agreed likely enemy, against which all preparatory efforts can be concentrated. Implicit in this is the availabilty of comprehensive, accurate intelligence on that enemy.

Throughout the 1970s, wargaming proponents continued to refine their art. Better solutions were developed for the perceived shortcomings of wargaming, including the Mil/Pol games. The relative advantages and disadvantages of computer and manual wargaming also came to be better understood. Meanwhile computers became more powerful and cheaper, so they proliferated. The 1970s was also a period of greatly expanding interest in wargaming in the civilian (amateur) community.

By the early 1980s, the US defense community had come to realise that neither analysis nor gaming was the sole perfect tool for their needs. The two techniques had come to be seen as complementary (symbiotic). Combined, they can provide a balanced approach to many defence problems. Analysis often generates the models that form the foundation of a wargame.[28]

Operational and Tactical Wargaming

The individual US Services each developed wide ranges of operational and tactical level wargames. In the old Prusso-German tradition, wargaming became a standard step in the planning and training processes. Rather than a separate activity to be employed in exceptional cases, wargaming became part of a seamless continuum that includes large scale field exercises, which test and train.

US Navy Wargaming. As early as 1948, the US Navy began designing an automated operational/tactical level fleet wargame. The Naval Electronic Warfare Simulator (NEWS) took $10 million and a decade to develop. During its long gestation, new technologies (nuclear weapons, jet aircraft and guided missiles) radically changed the nature of war at sea and computer simulation techniques evolved rapidly.[29]

NEWS was first played at the Naval War College in 1958. The enormous 'number crunching' power of computers freed the human participants from much of the time-consuming mechanics of gaming, allowing them to concentrate more on exploring issues, learning about processes and making decisions.

In 1966, the US Navy began developing the Warfare Analysis and Research System (WARS), which would ultimately simulate the naval combat environment from 200,000 feet above the ocean surface to 10,000 feet below the surface. WARS can be

played at up to 40 times faster than real time.[30] In the late 1970s, WARS was replaced in the late 1970s by the even more capable Naval Warfare Gaming System (NWGS), which is played over 100 times a year and is used for education, research, operational testing and fleet readiness exercises.[31] Today, shipboard computer simulations and table top wargames are routinely integrated with USN fleet manoeuvres at sea.

US Army Wargaming. In the 1950s, the US Army began a series of integrated wargames and field exercises at the tactical and operational levels that gradually evolved into the comprehensive system currently used at the National Training Centre (NTC), Fort Irwin, Nevada. At the NTC, the distinction between wargames and field exercises is blurred into a continuum.

Entire brigades are put through the NTC programme, which includes an electronic battlefield on which the BLUE brigade can fight a RED Opposing Force (OPFOR). OPFOR thinks RED. It employs Soviet tactics and uses captured Soviet equipment. NTC is the US Army's equivalent of the USAF's RED FLAG and COPE THUNDER and the US Navy's Top Gun. The training is now a routine part of unit preparation for all overseas deployments, including NATO (Germany), Korea and the Middle East (Operation DESERT STORM).[32]

USAF Wargaming. The USAF has also integrated wargaming techniques with realistic field exercises on electronic ranges (eg: RED FLAG in Nevada and COPE THUNDER in the Philippines). As at the Army's NTC, the RED force uses Soviet style tactics and aircraft that are Soviet look alikes. The RED squadrons are called 'Aggressors', the same title originally used by the Army for its OPFOR units.

ISRAEL

Ironically, many of the military techniques in which the Germans once excelled are now practised by the Israelis, including wargaming. The Israelis have made extensive use of all forms of wargaming and are obsessed with realism. The basic principles of Israeli wargaming are:

a. play with real people, usually the subordinates as close to the primary decision making as possible (the junior commanders);

b. play with real data;

c. play with real manuals, orders and procedures;

d. play with real problems;

e. play in real time, to avoid wrong lessons; and

f. play in real psychological environments (realistic pressure in the field).[33]

COMMERCIAL WARGAMING

Prior to World War Two, the military was the only market for serious wargames, but it was too small a market to be profitable. The only commercial wargaming product on the market was toy soldiers. All 'professional' wargaming was developed within a small group of military experts.

In 1958, the Avalon-Hill company was formed, in the US, by a young hobby wargamer. Avalon-Hill marketed the world's first professionally produced, serious wargames and were selling about 200,000 a year by 1962. In 1964, the first mass circulation wargaming periodical, 'The General', was published. In the mid 1960s, Avalon-Hill's sales slumped, due more to marketing problems than a lack of demand for wargames.[34]

In 1968, Simulation Publications Incorporated (SPI) was formed, in the US, by a group of professional wargamers who had previously developed wargames for the US armed forces. In 1969, they began publishing their own periodical, 'Strategy and Tactics', which eventually had a circulation of over 100,000. SPI developed a more effective advertising/marketing strategy and led a renaissance in commercial wargaming.[35] By the early 1970s, many new companies were designing and marketing wargames.

Between 1960 and 1980, over 12 million wargames were sold, most in the US. The 1970s was a period of steadily growing sales and of many innovations in gaming technique. One new type of game developed was the Fantasy game (eg: Dungeons & Dragons and a range of more realistic wargames set in a post nuclear holocaust environment).

The proliferation of personal computers, in the 1980s, led to the development and marketing of many simple automated wargames. Today, many companies in many countries (including a few in Australia) are marketing realistic computer wargames that simulate every campaign from Julius Caesar's conquest of Gaul to Star Wars. Most commercial computer wargames are still little more than arcade games, but some operational level (mainly land warfare) games are appearing. Annex A details the milestones in commercial wargaming history. Annex J summarises the main commercial sources of wargames.

One important side effect of the explosion of civilian interest in wargaming in the 1970s was the growth in the number of military personnel with wargaming interests and skills. This pool of people, for whom wargames hold neither fear nor mystery, is a potentially useful untapped resource.

WARGAMING TODAY

Today, wargaming is again very popular in military circles, as a result of the coincidence of many factors. These factors include improvements in the art itself and economic pressures that forced the abandonment of other techniques.

Much more realistic wargames can now be developed. Powerful (but relatively cheap) new computers can manipulate huge data bases and simulate very complex realities. Also, in recent years, many innovative gaming techniques and mechanics have been developed to facilitate new approaches to problems and further enhance the realism of wargaming.

Wars are becoming less frequent and of shorter duration, so the number of combat experienced warriors is dwindling. This increases the need for realistic training. At the same time, defence budgets are shrinking. Meanwhile the soaring cost of military equipment and manpower continue to force defence planners and trainers to turn to simulation, as the only affordable means.

Most Western (and Soviet) armed forces are increasingly using wargaming in their training and planning processes. The NATO forces, particularly the US, now use wargaming extensively and tend to want to wargame everything. In 1990, the US Department of Defense spent tens of millions of dollars generating new wargames, most of which were analytical and the US wargaming community numbered about 1,000 (with a payroll of over $25 million).[36] The US, UK and Canadian War Colleges and Command and Staff Colleges include weeks of wargaming in their curricula. Large professional wargaming centres now exist at the USAF Air University and US Naval War College.[37]

Wargames are big business for companies such as RAND, which has been conducting studies and generating computer models and wargames since the early 1950s. Most of these focus on aspects of superpower conflict in Europe (NATO v WARPAC), particularly nuclear exchanges (the mechanics of Armageddon). They examine politico-military issues, high level decision making, command and control, logistics and the dynamics of all facets of combat.

Each summer for the last 12 years, a superpower wargame called 'Global War Game' has been played at the US Naval War College. The players are senior commanders and staff officers from the Pentagon and major US Commands around the world (such as CINCPAC and USAFE). Over the 1984-88 period, one game play was continued from year to year.[38] The US military leadership considers such activities essential to preparedness.

Some authoritative observers warn that wargaming has become so popular that we must be careful to avoid promising too much, as was done in the 1960s. No wargame can prove anything beyond doubt or completely simulate reality. The dominant factor in war is still the human factor. It continues to defy reliable quantitative analysis and will confound the accountants.

WARGAMING IN AUSTRALIA

The Early Years

The Australian Services have been sending senior officers

to US and NATO War Colleges for decades. These officers, and our Defence Attaches, have been exposed to many of the wargames used by our allies. Unfortunately, most of these wargames have had little relevance to Australia, as they simulated major power conflicts in regions remote from Australia's area of interest.

The first attempts to develop wargames suited to Australia's strategic environment date back to the early 1970s and were driven primarily by the Army. In 1972, LTCOL (now MAJGEN) J.C.Grey returned from a visit to the US, impressed by the potential of wargaming and wrote a paper, recommending that the Australian Army begin using wargames. The recommendation was endorsed and wargame design and development began. In 1977, a Field Force Command War Gaming Conference, chaired by COL (now LTGEN) H.J.Coates, reviewed the progress made and confirmed the value of wargaming to the Army. The conference recommended greater use of wargaming in the Army (including the acquisition of US DoD and MOD UK wargames) and defined a policy for the coordination of Army wargaming.

In the 1970s, the Services Analytical Studies Group (SASG) in Canberra developed a series of manual and computer assisted wargames. These wargames were based on scenarios considered more likely to face the ADF than global nuclear war. They simulated operational problems, such as the management of air/land/sea operations in northern Australia, and related support activities, especially logistics. This early Australian foray into the wargaming arena is explained in greater detail at Annex B.

The State of the Art in Australia

Army Wargaming. In 1984, the Australian Army established the Army War Games Centre (AWGC). AWGC strength in 1990 was 32 officers and NCOs (20 ARA and 12 ARES) and a civilian software engineer. The AWGC uses only computer assisted and automated wargames, which are rather expensive to maintain. The AWGC budget for 1991 is $600,000, exclusive of salaries. AWGC roles are to develop training and analytical wargames and foster wargaming skills in the Army.

The AWGC has acquired several US wargames and developed one of its own (which the US in turn acquired). Only tactical CPX wargames (mainly at battalion and brigade level) have been used in the 1980s, but one wargame (JANUS) could be used as an analytical game. Details of AWGC wargames are at Annex C.

Joint Wargaming. Simple manual tactical wargames, based on US and British models, have been important regular features of the joint warfare courses conducted at AJWE and AJASS for many years. Several generations of Australian maritime warriors chased submarines around the gaming floor at NAS Nowra, in techniques that would be familiar to Admiral Nimitz. The ADF Warfare Centre (ADFWC) has inherited this gaming tradition.

The automated CPX has become a feature of most large ADF exercises, such as PITCH BLACK and the KANGAROO series. Senior politicians were involved in some of the K89 gaming activities.

In February 1991, largely as a result of a paper written by Commodore Bateman, a wargaming cell was established at ADFWC to investigate the application of wargaming to high level (AIRCDRE and above) decision-making training in the HQADF environment. After visiting their prospective customers (HQADF, Land HQ, Air HQ and Maritime HQ) to establish requirements, the team investigated a promising 'short cut' to developing its first operational level HQ wargame - the adaptation of component models and methodologies from commercial wargames. Their findings were that the 'short cut' will save much time and money and still produce valid wargames.

RAAF Wargaming. In 1990, CAS awarded a fellowship to one officer to study the application of wargaming to RAAF training.[39] This thesis is one product of that fellowship study.

Another early result of the fellowship study was to focus high level interest in wargaming. In April 1991, Air HQ accepted an Air Power Studies Centre (APSC) recommendation that operational level wargames be developed for use by the Battle Staff, initially as a training tool, but ultimately for the full range of wargaming applications. A team of Air HQ and APSC officers is developing the concept now.

WARGAMING ELSEWHERE IN OUR REGION

All the nations in our region send senior officers to the same US and British war colleges and staff colleges as the ADF. Those officers have had the same exposure to wargaming as our students and their parent Services have all shown an interest in developing indigenous wargaming capabilities and/or using US material. Some have been wargaming longer than the ADF. A few examples of their wargaming activities are given below.[40]

Malaysia

Having experienced the brutal deprivations of hostile occupation (by the Japanese between 1942 and 1945), the Malaysians take defence very seriously. Lacking the resources of more developed nations, they embrace economical methodologies enthusiastically. The Malaysians have used wargaming for many years, as a research, planning and training tool.

In the 1980s, an Australian Army wargamer (Mr Tom Millane) was seconded to the Malaysians to assist in their wargaming. They used wargaming to explore and compare options for simultaneously defending their east and west coasts with limited air and naval assets. The gaming helped them evolve force structure, deployment and doctrine.

India

The Indians also use wargaming extensively in their training and doctrine development. For example, the Indian Army has experimented with mechanised unit (armoured brigade) cross country mobility, using gaming techniques.

CONCLUSION

Since the Prussians began wargaming to help solve practical military problems (170 years ago) the technique has been widely recognised and used as a valuable planning and training tool. Even nations with limited resources have seen wargaming as a cost effective (and sometimes the only) means of preparing for war. Applications have included:

a. CPX and HQ planning exercise driver (as originally used by the Prussians),

b. preparation for major exercises with troops in the field (the Prussians again),

c. force structure and force level determination (eg: German U-boat force levels),

d. doctrine development (eg: Luftwaffe air power doctrine),

e. strategy development (eg: US Navy strategy for war against Japan in the Pacific),

f. operational campaign planning (eg: German conquest of France in 1940),

g. tactics development and training (eg: German U-boat tactics), and

h. logistics organisation and procedures development and evaluation (widespread use since the Prussians).

Throughout history, the outcome of battle has defied reliable prediction, because the human factor cannot be reduced to precise mathematical formulae. Just as 300 Spartans could not have been expected to make such an effective stand at Thermopylae, many modern battles have developed unexpectedly. Wargaming has been shown to be a unique way of exploring the dynamics of warfare (the problems and the possibilities), but it has never 'proven' anything or predicted an otherwise doubtful outcome.

The 'lessons' learnt from wargaming have always been for the guidance of wise soldiers and the blind obedience of foolish ones. Wargaming is only one of many tools, best used together with experienced judgement. Used wisely, wargaming has been an important factor in many of the great military successes of the century.

The ADF (the RAAF in particular) has barely begun to exploit the potential of wargaming. The next chapter explains the nature of wargaming and how it is being used by other services.

ENDNOTES

1. Perla, Peter, The Art of Wargaming, Naval Institute Press, Annapolis, 1990, pp 15-16.

2. Dunnigan, Berg, Isby, Patrick and Simons, Wargame Design: The History, Design and Use of Conflict Simulation Games, Simulation Publications Inc, New York, 1977, p 2.

3. Perla, pp 19-21.

4. Prados, John, Pentagon Games: Wargames and the American Military, Harper & Row, New York, 1987, p 3.

5. Dunnigan, p 3.

6. Perla, pp 30-31.

7. Perla, pp 31-32 and 40-41.

8. Perla, pp 48-50.

   The Russians used wargaming as a planning tool for their invasion of Prussia in 1914. The wargames highlighted the fact that their forces would be split as they passed the Masurian Lakes and may be vulnerable to defeat in detail, if the Germans seized the opportunity.

   The Russian generals who commanded the field armies in 1914 had participated in the wargames, yet they failed to take adequate precautions to insure against the Masurian problem.

   The Germans had also (through wargaming) identified the opportunity that the Masurian Lakes presented. In the battles at Masurian Lakes and Tannenberg, the Germans won quick, decisive victories against unfavourable odds, by massing the bulk of their forces, first on one side of the lakes and then the other, defeating the Russian armies one at a time.

9. Wise, Terence, Introduction to Battle Gaming, Model & Allied Publications Ltd, UK, 1969, p 10.

10. Perla, p 38.

    Several commercial wargames were published in the years leading up to 1914. Fred T. Jane (editor of 'Janes Fighting Ships') developed a naval combat game similar to the modern children's game 'Battleships', but with a very complex battle damage resolution model.

11. Flammer, 'The Schlieffen Plan and Plan XVIII: A Short Critique', in Military Affairs, Winter, 1966/67, pp 207-212.

12. Dupuy, Trevor, A Genius for War: The German Army and the General Staff, MacDonald & James, London, 1977, p 266.

13. Manstein, Erich von, Lost Victories, pp 119-121.

The critical point in the German invasion of France was the crossing of the Meuse river by the Panzer Divisions on 14 May 40.

The campaign ran so smoothly in accordance with the wargame conducted on 14 Feb 40, that the Chief of Staff of one Panzer Division was able to use the operations orders that he had written for the wargame for the actual river assault.

14. Murray, Williamson, Strategy for Defeat: The Luftwaffe (1933-1945), Quintet Publications Ltd, London, 1986, p 17.

Having all come from the Army, the early Luftwaffe officer corps were familiar and comfortable with wargaming as a tool for planning, training and doctrine formulation. In 1934, Goering tasked a senior Air Ministry official to conduct a study, including wargaming, to develop a doctrine and strategy for his new air force.

The first Luftwaffe Chief of Staff (General Wever) believed in strategic bombing, but even if he had lived, he would have had to accept the wargame indications that large scale strategic bombing was simply beyond Germany's resources and far less promising a means of quick victory in the coming war than the 'Blitzkrieg'.

15. Perla, p 43.

Wargaming enabled Doenitz to confirm and quantify his ideas on U-boat force levels. His gaming established that a fleet of 300 boats was required to ensure quick victory against Britain. This was accepted by the German leadership as a planning target (part of the famous 'Z Plan', that was meant to have been achieved by the time Hitler had planned to go to war, in 1944).

Fortunately for the Allies, when the war broke out, the Kriegsmarine had only about 60 boats.

16. Snyder, Frank, 'What is a Wargame?', in Naval War College Review, Autumn 1990, pp 47-51.

17. Snyder, p 51.

18. Snyder, p 51.

19. Perla, p 45.

20. Perla, pp 45-48.

The Japanese wargamed every operation in the Pacific.

The Japanese admiral who umpired the Midway wargame arbitrarily changed the outcome of the initial engagement, to preserve the Japanese carriers, so the game could be played out, rather than end prematurely.

However, in the post game analysis, he warned that the original results should be taken into account and that their operational plan should allow for the possibility of an American ambush from the north. The Japanese planners failed to heed his advice and the worst case scenario happened.

21. Perla, pp 41-42.

Mil/Pol gaming was pioneered by the Germans. Von Manstein suggested adding the political dimension to a wargame in 1929.

The scenario assumed a Polish invasion of Prussia (a real possibility at the time). Civilian bureaucrats and diplomats from the Foreign Ministry were invited to participate and played the roles of President of the League of Nations and key German and Polish political leaders.

22. Jones, William, RAND Note on Free Form Gaming, N-2322-RC, 1985, p 1.

23. Prados, pp 8-9.

The organisation's titles have included:

a. Studies Analysis Gaming Agency (SAGA),

b. Strategic Analysis Division, and

c. Force Structure Resource & Assessment Directorate (J-8).

It now has 42 military officers and three civilians.

24. Prados, pp 8-9.

25. Perla, pp 123-128.

26. Perla, pp 47-48.

The Japanese went to extraordinary lengths to 'Think RED'. When Military and Naval Attaches returned to Japan, at the end of their tours, they were virtually quarantined, to preserve their foreign perspective. They then participated in wargames, as members of the RED (enemy) team. Their recent intimacy with the 'enemy' was seen as an opportunity for unique insight into the occidental military mind.

27. Perla, p 123.

28. Perla, pp 147-150.

29. Prados, p 7.

30. Prados, p 7.

31. Prados, p 7.

32. Prados, pp 5-6.

33. Perla, p 156.

34. Dunnigan, James, The Complete Wargames Handbook, Morrow, New York, 1980, p 143.

35. Dunnigan, pp 144-145.

36. Prados, p 9.

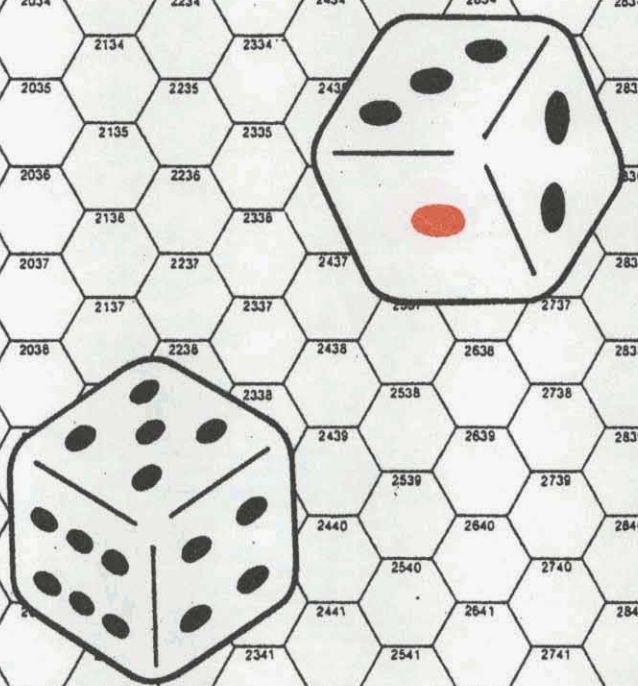
37. In 1990, the USAF Wargaming Centre at Maxwell AFB had a staff of about 100. The US wargaming centres (each Service has one) also make extensive use of reservists, personnel loaned from the intelligence community (CIA, DIA, NSC etc), other government departments (eg: State) and civilian contractors.

38. Snyder, pp 51-52.

39. In the 1970s, a few senior RAAF officers were involved in the wargaming activities at SASG. Some attempts were made to stimulate RAAF interest in wargaming, but high level official interest was never excited. Most early RAAF wargaming efforts foundered, without trace.

40. The information on Malaysian and Indian wargaming was provided by Mr Tom Millane (office of the Army Scientific Adviser) and is based on his first hand experiences.

CHAPTER TWO



THE NATURE OF WARGAMING

THE NATURE OF WARGAMING

'Every historical situation has dynamic potential, but most histories are presented as a linear rendering of what happened, with no potential for exercising the dynamism. Wargaming is just the opposite.'
James Dunnigan, SPI, 1980.

INTRODUCTION

The term wargaming covers a wide range of activities, from children playing with toy soldiers in the sand to complex computer simulations of global thermonuclear warfare by Pentagon officials. In the context of its application to military training, wargaming can be defined as:

A simulated military contest,
conducted according to rules,
with participants in direct opposition to each other
(or to the umpires or game control system),
without using actual combat forces.[1]

This chapter will explain the nature, characteristics and purposes of wargaming, as used by the military, throughout the world.

GAMING VERSUS ANALYSIS

Wargaming is often confused with operations research and analysis (hereinafter analysis, for brevity's sake) The techniques are essentially different approaches to similar problems. One way of illustrating the nature of wargaming is to compare the broadest form of wargaming, the military/political (Mil/Pol) game, with the narrowest form of analysis. A tabular comparison of gaming and analysis is shown at Annex D.

Analysis is very objective and mathematical in nature, while gaming is subjective and realistic (chaotic). The aim of analysis is to precisely measure a physical phenomenon and thereby determine a precise answer to a specific question. The aim of a Mil/Pol game is to explore qualitative issues, not to find a precise measured answer but to illuminate plausible, practical approaches to a broad problem.[2]

Analysis has a narrow focus on a specific piece of reality, such as comparing the cost effectiveness of an F/A-18 strike to an SSM strike on a specific target. A Mil/Pol game has a much broader focus and attempts to simulate a whole real world scenario, such as a regional conflict where even the neutral nations' intentions and actions are considered.

Analysis and gaming treat variables differently. In analysis, variables are simplified to the point of abstraction or

just totally ignored. In a Mil/Pol game, the variables are simulated in maximum detail. The ultimate variable is the human factor. Analysis tries to eliminate the human variable, but Mil/Pol gaming focuses on it and explores all known political, social and psychological factors.[3]

Analysts tend to prefabricate (fix) the decision processes in their models, to minimise the uncertainty inherent in the human factor. A Mil/Pol game designer leaves the decision options open, as gaming is meant to force the human participants to make decisions and live with the consequences.[4]

Analysis is a science but gaming is more an art. There is a 'grey area' - analytical games - which share the aims of pure analysis and the methodology of gaming. However, most analytical games are still rather narrow in their focus and their treatment of reality.

The precise mathematical nature of analysis makes the computer its obvious and ideal tool. Computer assistance (automation) can be useful in wargaming, but the computer architecture and processes must not be allowed to dominate the wargaming process. The principal advantage of gaming is that it allows the human participants to influence events in human ways that computers can never anticipate. In wargaming, there should be opportunity for positive human behaviour (such as inspired 'hunches', intuition, educated guesses and calculated gambles) and negative human behaviour (such as vacillation, procrastination and spectacular, inexplicable stupidity).

A simpler explanation of the difference between analysis and training/education was provided in the report on a recent wargaming conference in the US.[5] The report states:

> *'Military men, when not fighting in a war, seek to improve their own and their troops' proficiency in the conduct of war and they also seek a better understanding of war. The former is training and education; the latter is analysis.'*

So, they differentiated on the basis of the overall objective of the gaming, rather than technique.

PURPOSES OF WARGAMING

In the art of wargaming, the US armed forces are currently the leading theorists and practitioners. Wargaming in the NATO nations and elsewhere tends to follow the US pattern. US wargaming defines the current bounds and range of wargaming. In 1987, the US Joint Chiefs of Staff (JCS) adopted a 'Taxonomy for Warfare Simulation' (SIMTAX), which provided the first comprehensive means of classifying and comparing wargames.[6] SIMTAX provided the structure for the JCS Catalog of Wargaming published in 1989, and it is a convenient system for the RAAF to use.

SIMTAX defines the broad purposes of professional military wargaming as being analysis and education/training.

Analytical Applications

The analytical applications of wargaming include the development of operational support tools (decision aids) and research and evaluation tools.

Operational support tools include automated battle management systems that classify and prioritise threats to relieve the human decision-makers (commanders) of that mechanical task and highlight the immediate threats on which they must concentrate.

Research and evaluation tools can be used for weapon system development and evaluation, combat development and a range of force assessments.

Weapon system development and evaluation is fairly self-explanatory. Combat development can lead to the formulation doctrine, strategy and policy.

The force assessments can include force capability and requirements assessments (including course of action assessments for such things as crisis management), force mix assessments, force effectiveness assessments and resource planning (including personnel and logistics management).

Force capability/requirements and weapon system applications tend to focus narrowly on determining precise, quantifiable technical and fiscal answers. The subjective political, social and psychological issues are usually not factored into such analysis, even though these human factors are often decisive in conflict. Such analysis often produces the models that are built into the broader strategic, operational and tactical wargaming. Analysis is best left to scientists and engineers at organisations such as DSTO.

The analytical gaming aimed at assisting in the formulation of doctrine, strategy and policy, treats issues more broadly and is of more immediate relevance to the military, especially to the RAAF. The issues raised in such documents as the Dibb and Wrigley reports, the Defence of Australia White Paper and the RAAF Air Power Manual would be suited to examination by analysis gaming. This could lead to refinement of RAAF (and national) doctrine, strategies and policies.

Training and Education Applications

Training and education wargaming, being broader in its treatment of issues and oriented more towards processes and human factors than analysis, is the most relevant area of wargaming for the RAAF. The training and education applications of wargaming include team and individual skills development and exercise drivers (for field training exercises, command post exercises, seminar exercises and individual exercises).

Typical applications of training and education wargames in the RAAF could include officer education and exercise driving.

The integration of educational wargaming into officer education (at all levels) could help raise air power awareness and promote the self-image of 'the profession of arms' in a uniquely air force sense.

An integrated program of wargaming as exercise drivers in headquarters at all levels in the RAAF would be a cost-effective means of improving the executive decision-making and battle management skills of commanders and their staffs.

CHARACTERISTICS OF WARGAMES

Wargames can be described in terms of the following characteristics.

Scope

The scope of a wargame is the nature of the conflict being simulated. It includes the following forms of warfare:

a. conventional warfare by regular, uniformed field forces;

b. unconventional warfare (eg: guerillas, partisans, terrorists);

c. nuclear warfare (ie: tactical, pre strategic, strategic);

d. biological warfare;

e. chemical warfare;

e. electronic warfare (ie: ESM, ECM, ECCM);

f. mine warfare (ie: naval and land mines);

g. special operations (eg: SAS, Commandos, Rangers);

h. special weapons/sensors (eg: laser, IR, EO); and

i. logistics support, including industrial mobilisation and civilian infrastructure.

A wargame can simulate a combination of the above types of warfare, such as nuclear, biological and chemical (NBC). Scope can also include other aspects of military activity (detection and verification) and measures short of armed conflict (political and economic).

Span

Span is the geographic extent of the conflict being simulated. The span of a wargame can be global, regional, inter-theatre, theatre, intra-theatre, sector, local or individual.

Environment

The environment in which the conflict occurs includes both the characteristics of the reality being simulated and the manner in which it is represented. The manner of representation ranges from highly realistic digitalised survey maps to more abstract hexagon-based systems. Representation is explained in more detail at Annex E.

The characteristics of the real world being simulated can include:

a. air, land, sea or space (including undersea);

b. terrain (swamp, mountains, plains, urban);

c. vegetation (jungle, grassland, tundra, desert);

d. meteorological conditions (including weather and seasons);

e. time of day (day/night or sunrise/sunset);

f. man-made environments (EW, NBC); and

g. special features, such as trafficability and cultural sites (cathedrals, monuments, etc).

Terrain is the factor that is sometimes overlooked in air power wargames. Terrain features can be used to mask a strike aircraft (at low level) from detection or the attentions of the enemy SAMs and AAA, during ingress and egress. Terrain features (such as high mountains and narrow valleys) can also limit the strike aircraft's options and simplify the task of limited air defence assets.

Openness

The degree of openness is the extent of knowledge made available to game participants. A wargame can be open or closed.

In an open game, all participants have open access to all information on each other's ORBATs, capabilities, deployments, objectives and options. An example of an open game is 'chess'.

In a closed game, each side's knowledge of the opposition and the control group (umpires or game system) is limited. No game can be totally closed, as there is always some knowledge of the rules and the environment, but varying degrees of witholding are possible. An example of a closed game is 'poker'.

Rigidity

Rigidity refers to the degree to which game dynamics and outcomes can be influenced by game participants (usually the umpires). In a rigid wargame, there is a model or table to determine every detail of movement, interaction and outcomes. All the umpires do is apply those models and tables. The original Kriegspiel was a very rigid wargame. Automated wargames also tend to be rigid.

At the opposite end of the rigidity spectrum is the 'free form' wargame, in which rules are kept to an absolute minimum and unstructured interaction among players is encouraged. Outcomes are assessed subjectively, case by case, on the basis of human (umpire) judgement and experience. The umpires can intervene and 'move the goal posts'. Free form gaming's alternate titles shed further light on its nature - seminar gaming, crisis gaming and military/political gaming.

Free form gaming is the most flexible form of the art of wargaming. It has been used in the US to explore broad national policy issues such as responses to the threats or actions of a potential enemy, identification and comparison of alternate courses of action in international confrontations, intervention in ongoing conflicts and responses to terrorism.[7]

Free form gaming has also been used to explore narrower military and non-military issues. Such issues have included the political, legal and social problems associated with constructing a potentially hazardous industrial facility in an urban area; the problems entailed in deploying and protecting uncommitted specialised combat units (eg: a reserve mobile missile unit) in combat and the possible inadequacies in the political and military assumptions underlying military contingency plans.

The highly structured nature of rigid wargames makes them easy to umpire. Umpires need make few decisions during game play (beyond rule interpretation), as most matters are resolved by consulting a table or computer model.

The free form game is very difficult to umpire. Umpires are faced with as many decision points as the players. They must constantly make subjective decisions on the basis of the developing flow of the game and the players' backgrounds and performance. The umpires must rely heavily on their experience, both of the reality being simulated and wargaming methodology, as the game system provides little structure for support.

Automation versus Manual Gaming

The degrees of automation in wargaming are no automation (manual wargames), partial automation (computer-assisted wargames) and total automation (computer wargames).

In manual wargames, all game functions (including set up, movement, combat, record keeping, rule interpretation and umpiring) must be performed by the human participants. The playing surface is a map board or table. Manual games are

manpower intensive to conduct. To facilitate timely play, manual gaming packages must include:

a. combat resolution tables, to aid in determining engagement outcomes and calculating attrition;

b. movement tables, to quantify such mobility factors as terrain effects;

c. random events tables, to integrate extraneous factors such as weather, political interference, events in offmap areas of operations and the chance availability of reinforcements, replacements and special forces; and

d. proformas, to facilitate mission planning, logistics management and record keeping.

In computer-assisted wargames, a map board or table is still the playing surface and the human participants must still perform set up and movement manually, but computers are used to 'number crunch' the attrition and logistics calculations. Record-keeping may be manual or partly or fully automated.

In fully automated wargames the playing surface is the VDU screen and set up, movement, combat and record-keeping are all 'at the touch of a button'. Players input their moves to the computer, which automatically filters them through the rules (rejecting any inputs that are incompatible with those rules), resolves engagements (calculating and implementing attrition and any enforced retreats) and manages the functions not central to the objective of the wargame (such as logistics functions in a battle simulation or combat dynamics in a logistics game).

The first use of computers to support wargaming was at the US Naval War College, in 1958. Prior to that, all wargaming had been manual, but manual wargaming fell out of favour as the use of powerful computers became more widespread. Most of the wargaming conducted by Western armed forces today is automated.

Advantages of Automation. Until such time as true artificial intelligence can be perfected and applied to wargaming, the advantages of computer wargaming over manual wargaming are as follows.

Computers can 'number crunch' very quickly, thereby relieving human participants of much of the time consuming game mechanics, freeing them to think and learn.

Computers can master large sets of rules and ensure that players do not accidentally (or intentionally) make moves that violate those rules. Such mistakes are easier to make and harder to detect as game complexity increases.

Computers can manage huge data bases. This capability is important because, as realism increases, so too does the complexity of the data base. Without computer assistance, the high resolution (fine detail) simulations would become unwieldy.

Computer wargames 'play' much faster than corresponding manual wargames, thus making fewer demands on senior officers' limited time.

Computer wargames can be conducted in rapid series, with one or more of the variables changed each time, to see how the changes affect outcomes (or the performance of the participants).

Computer software can include a post processor, which compiles detailed reports of all moves, engagements, outcomes and other game events. These reports form the basis of the debriefs that are essential to the learning process.

Computers can be programmed to play a wargame (against themselves) over and over again at high speed. This can quickly produce a library of alternative game plans, interactions and outcomes, for the purposes of analysis, validation or education.

Disadvantages of Automation. Computer wargames are not the perfect solution for every requirement. They have some disadvantages, including the following.

Software development is very expensive. It can only be justified when a wargame is going to be conducted many times.

Most PC graphics packages have physical limitations (in terms of resolution and scope), which necessitate larger, more expensive hardware (mini or even mainframe computers) to match the graphics available on manual wargame maps.

Human participants have a tendency to mistrust the data base and models built into computer wargames. The mechanisms are 'buried' in the software. The lessons learnt are also 'buried' in the software and are not easily examined and understood.

Advantages of Manual Wargaming. There are many applications for which manual wargames (and computer-assisted games) are adequate and much more economical. The advantages of manual wargaming are as follows.

Manual wargames are less rigidly structured than computer games. This allows participants more freedom to experiment and make mistakes. So, they can explore more creative ideas and will often learn more.

Manual wargames are more flexible and can be used to study dynamic processes and force interactions that are only partially understood and so cannot be fully quantified for analysis.

Manual wargames can be used in an education role, to build up participants' background knowledge of issues, processes or regions, in preparation for deeper studies or analysis.

Manual wargames are manpower intensive to set up and conduct, so the cost is in the implementation phase rather than in development. This makes manual gaming the better solution when the wargame will be conducted infrequently.

Disadvantages of Manual Wargaming. The disadvantages of manual wargaming include the following.

Manual Wargames are manpower intensive (expensive) to conduct. Trained and experienced human umpires and support staff are required to run the game.

The results of manual wargames are usually not easily reproducible. Manually kept records of play can never be as complete as computer records.

Human players and umpires may overlook an honest mistake, try to abuse ambiguities in the rules or just cheat. So, manual wargames are more prone to error.

Contemporary reality is constantly changing, as new technologies and techniques are applied to military problems. Realistic contemporary wargames thus have short shelf lives. Introducing amendments to a manual game is usually more time-consuming than amending computer wargame software.

The conduct of manual wargames requires many tables and charts. The rules must be totally mastered before play, since there is no computer to validate moves and cue participants. So, manual wargames are more difficult to play.

The choice between automated and manual wargaming is a trade-off in realism, playability and flexibility. The compromise reached will be determined by the objective of the wargame.

Human Participation

The degree of human participation in wargaming ranges from total involvement, in a manual game (where the human participants perform all movement and combat functions) to zero human input, in some analytical computer games (where the computer performs all functions and plays itself, over and over). Wargames designed to exercise human decision-making or explore human issues and processes, should only use computers to manage mechanical aspects of the game.

Randomness

The armed forces do not always operate perfectly in war. Unforeseen equipment malfunctions and human error have often snatched defeat from the jaws of victory. It would be unrealistic to conduct a wargame in which Murphy's Law does not operate. Wargames must have a mechanism for introducing chance (randomness), to simulate the uncertainty inherent in human interaction.

The two extremes in terms of randomness are the deterministic and the stochastic. In deterministic simulations, all outcomes are predictable - the element of chance is not included. In stochastic simulations, outcomes are never predictable - all are subject to chance or probability.

Assume a simulation with a SAM system that is credited with a probability of kill (pK) of 90%. Successive formations, each of 10 aircraft, fly into the SAM system's engagement zone. In a rigid deterministic simulation, nine aircraft will always be hit. In a stochastic simulation some mechanism or model will apply a random factor and the actual losses in each engagement can range from zero to 10. Over a statistically significant sample, it will still average 90%, but during one run of the wargame a player could 'get lucky' and score an 'upset' victory. This random 'luck' factor is the reason that such treatment of randomness is called the Monte Carlo method.

In such a simulation there would actually be several algorithms or models, working together to determine the overall probability. These models could determine the probability of:

a. target detection (search radar),

b. target acquisition or 'lock on' (fire control radar),

c. weapon functioning (clean launch, controlled flight, accurate guidance and successful detonation),

d. adequate lethality (the target may only be damaged, which may not prevent it from completing its mission), and

e. the strike aircraft being able to deliver its weapons before it is destroyed or forced to break off the attack.

A crucial outcome modifier in combat is the 'odds'. Based on the general principle that your chances of success increase in direct proportion to the amount of combat power that you apply, most combat resolution models apply different ranges of outcomes as the odds change. The relationship between odds and outcomes is often geometric rather than arithmetic. Increased odds (10:1 as opposed to 2:1) overwhelm the opponent, with fewer friendly losses, for several reasons.

With more firepower being applied to each enemy unit, they will be destroyed sooner and will thus get less time to inflict reciprocal losses. Enemy return fire will also be spread over too many targets, so that its intensity is much less damaging. The enemy may be confused and/or scared by the oversupply of targets and thus use their firepower inefficiently.

There is a point at which the law of diminishing returns applies and further increasing the odds will pay marginal dividends. Annex F includes examples, from commercial manual wargames, of simple but effective combat results tables.

Randomness also operates to some extent in non-combat dynamics (which can also be handled either deterministically or stochastically). Such dynamics could include:

a. equipment failure, which can be anticipated by Mean Time Between Failure (MTBF) tables, but will be accelerated by overuse/misuse in combat emergencies or human error;

b. logistics support failure, due to simple human error, flaws in the system, enemy action or uncontrollable variables (eg: weather); and

c. command, control, communication and intelligence failures.

Any or all of these failures may occur in a spate at an unexpected point (or not at all) in any one run of a wargame, just as may battle casualties.

Time

In wargaming, time is an infinitely flexible variable. It can be compressed or extended; it can be stopped and restarted. Time can be dealt with in the several ways.

Events can unfold chronologically, at a constant rate, at any speed, including:

a. slow time, where participants may be given an hour to make a decision that would normally have to be made in a few minutes;

b. real time, where events unfold at normal pace; and

c. fast time, where events occur much quicker than in reality.

Events can unfold at a variable rate (any combination of slow, real and fast), as determined by the umpires or some preset game mechanism.

The game can 'time jump' (or event step) over periods of insignificance to significant events (which then run in real time), as determined by the umpires or some preset game mechanism.

Each of the above options has attendant advantages and disadvantages and is more suited to some types of wargame than others. The advantages and disadvantages of each is explained at Annex G.

Sideness

The traditional wargame has two sides. These are friendly forces (traditionally colour coded BLUE) and enemy forces (colour coded RED). However, there can be any number of sides in a wargame. There can be:

a. one side, where the umpires or computers act as the enemy (many analytical games are one sided);

b. three sides, with each opposed to the other two (a war triangle);

c. many sides, joining and withdrawing from shifting alliances of convenience according to disclosed or undisclosed criteria; or

d. the complicating factor of one or more 'neutrals', which may or may not intervene in the conflict (overtly or covertly) on the basis of known or unknown criteria.

CONCLUSION

Wargaming and analysis are different methods of studying problems. Analysis is a precise and narrow science, aimed at providing specific answers. Wargaming is an imprecise and broad art, aimed at exploring the impact of the human factor on real world situations.

In combination, wargaming and analysis have been useful tools for the following purposes:

a. developing team and individual skills,

b. driving exercises, such as CPXs;

c. preparing for exercises, such as the KANGAROO series;

d. formulating doctrine, strategy and policy;

e. developing and evaluating weapons systems;

f. resource planning and management; and

g. assessing:

(1) alternate courses of action (in crises),

(2) force mixes (structure), and

(3) force effectiveness.

ENDNOTES

1. My definition is a composite, inspired by those used by Dr Peter Perla (Center for Naval Analyses, USN) and Captain Frank Snyder (USN).

2. Mobley, Arhtur, Unlocking the Potential of Wargames: A look Beyond the Black Box, p 2.

3. Mobley, pp 4-5.

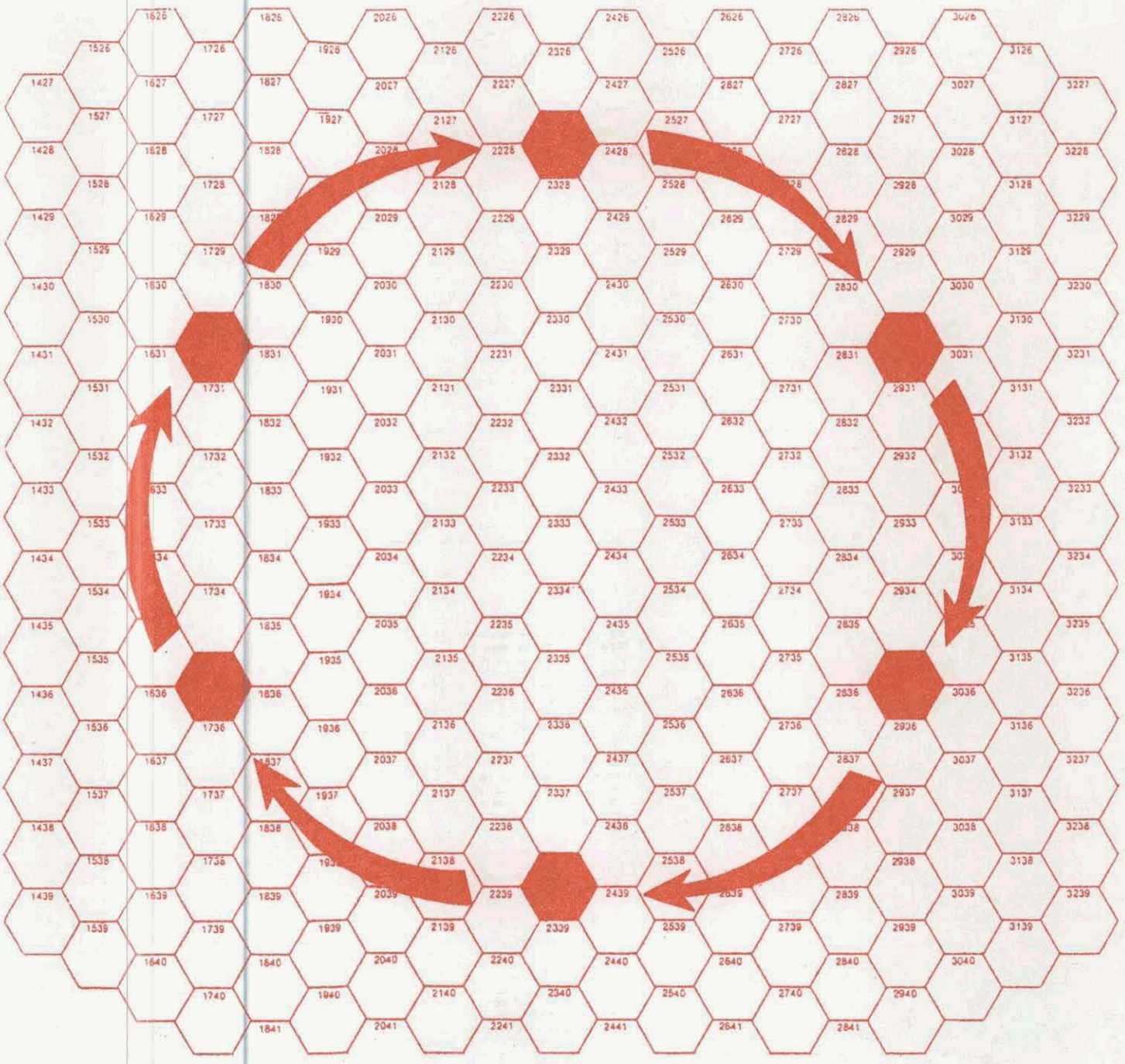
4. Mobley, p 4.

5. Anderson, L.B., 'A Taxonomy for Warfare Simulation', appears as Appendix C in US DoD Catalog of Wargaming and Military Simulation Models, 1989 Edition.

6. as above

7. Jones, William, On Free Form Gaming, RAND Note, N-2322-RC, 1985, pp 1-3.

CHAPTER THREE



A SYSTEMS APPROACH TO TRAINING WARGAMING

THE SYSTEMS APPROACH TO TRAINING WARGAMING

'Games are effective learning tools because they coax players to act and active learning is the best kind. Games also harness the players' spirit of competition. When games are played by teams, the competition also helps build team spirit and co-operation.'[1]

Alan Richter
Vice President
Quality Educational Development Inc

INTRODUCTION

The Manual of RAAF Training Procedures, DI(AF)AAP 2002.001, specifies:

a. the RAAF training philosophy,

b. a management cycle for all RAAF training activities, and

c. a policy for the conduct and management of all computer-based training (CBT) in the RAAF.[2]

The principles and procedures laid down in the Manual of RAAF Training Procedures are as applicable to wargames used for education and training purposes as they are applicable to the more familiar training methods used in RAAF trade training or pilot training. Wargaming used for analytical purposes must be developed and conducted in accordance with some system and the system applicable to education and training games is as valid as any.

This chapter explains broadly how RAAF wargaming (manual or automated, educational or analytical) should be managed, from the initial perception of a requirement for a wargame to the mature gaming system in use at a unit. Chapter 4 explains the process of wargame development and implementation in greater detail.

RAAF TRAINING PHILOSOPHY

The aim of RAAF training (and education) is to provide all members of the RAAF with the necessary knowledge, skills and attitudes to enable them to be effective members of the RAAF, within their designated categories or musterings. It ensures that the RAAF can perform as an integrated operational force in time of war.[3] The basic tenet of RAAF training evaluation is that the training conducted must be effective (the content and standards are relevant to the job) and efficient (it consumes the minimum of resources commensurate with meeting the objective).[4]

Wargaming is not always the most efficient means of meeting a training objective. Sometimes, it appears to be too manpower intensive and time-consuming. However, the decision whether to use wargaming is not always a clear cut objective case of costs.

When determining whether wargaming is a suitable method for satisfying a training requirement, either new or existing, the basic systems approach specified in DI(AF)AAP 2002.001 should be followed.[5] The systems approach to training (wargaming) can be summarised as:

a. identify the training (wargaming) need,

b. analyse the requirement (to determine whether a wargame will satisfy it most effectively),

c. design the training (wargame),

d. implement the training (wargame),

e. internally evaluate the implementation, and

f. externally validate the training (wargame).

RAAFCOL Wargaming - A Case Study

The Basic Staff course at RAAFCOL includes an air power studies package, EXERCISE AESCHYLUS. Students study major air campaigns since 1939, including the Battle of Britain, the Allied bombing of Germany, the Arab/Israeli Six Day War, the Rolling Thunder and Linebacker campaigns in Vietnam and the Falklands air war. The method of studying these campaigns was library research, mainly in after hours private study. Most students found it rather dry and unexciting, but it was easy for instructional staff.

Late in 1989, RAAFCOL staff considered changing the method of meeting the Aeschylus objectives from library research to wargaming. The history of the RAAFCOL wargaming project is a useful case study for highlighting the key issues associated with the use of wargaming as a training method. Wargaming was not considered on cost-cutting grounds, but rather in the belief that it would be more effective.

Wargaming can be the most stimulating (effective) way of studying campaigns. The competitive element could even prompt students to put more than the minimum effort into their studies and thus get more out of the exercise.

Wargaming can enable students to see both sides of each air campaign, rather than simply read the victors' version. Such an approach can dispell some of the myths (wrong lessons and wartime or post war propaganda) and open their minds to the fact that there are always options.

In a wargame, students can actually try out some of the famous 'what ifs' and some of their own ideas, to learn from the

effects of alternate tactics and strategies on outcomes. It also illustrates that the final outcome recorded in the history books was not inevitable.

A simple wargame at Basic Staff course level can give junior officers a simple, introductory exposure to wargaming, which will hopefully foster a greater awareness of its potential value in many applications throughout the RAAF.

None of these perceived reasons for introducing wargaming to the Basic Staff course is easily quantifiable or objective, yet all are valid reasons for changing (improving) the training.

The obvious disadvantage of applying wargaming to the RAAFCOL training is the cost - in terms of class time (in a crowded syllabus), development costs (including hardware).

Conducting meaningful wargames would take at least half a day of class time. However, if the RAAF can't afford to give priority to the study of air power - who can?

The design, development, implementation and conduct wargames could require significant extra staff effort and some new skills. There would also be the cost of wargame materials and (in the case of automated wargames) computer support.

The RAAFCOL approach was a 'pilot scheme', where wargames simulating one or two of the subject campaigns would be developed and implemented (at minimum cost) on a trial basis. Only a few students on each course would play the wargames, while most of the students satisfied the training objective by traditional means (as a 'control group'). The wargaming method could then be compared to the traditional method and its value assessed objectively. The further use of wargaming in RAAFCOL education and training could then be considered.

RAAF POLICY ON COMPUTER BASED TRAINING

Automated wargaming in the education/training environment is a form of computer aided instruction (CAI), as defined in RAAF CBT policy. Any wargaming used in the RAAF for education or training should be managed in accordance with RAAF CBT policy.

The RAAFCOL wargaming project provides a good case study. The initial plan was to locate suitable commercial board games and automate them, with the assistance of ADFA cadets in their final year of computer studies. RAAFCOL already possessed a computer system believed to be suitable for the task and the Commandant secured the part time assistance of an officer with an amateur interest in wargaming, to locate the games and co-ordinate the project. The advantages of the plan were hoped to include:

a. minimum cost, as the automation project would be part of the cadets' final ADFA practical assignment, so few scarce RAAF manhours and no

no expensive civilian consultants would be required; and

b. minimum disruption of the RAAFCOL training program, as:

(1) the bulk of the design and development work would be done by non-unit labour, and

(2) automated wargames were assumed to be easier for the staff (who had no wargaming skills) to conduct than manual wargames.

After a year, the feasibility of wargaming had been confirmed and two games had been automated, but their implementation was delayed by software and hardware problems. The graduation of the ADFA cadets and their posting to FTS deprived RAAFCOL of the very programmers who could have solved the software problems (within a few months). The hardware problems could be solved by buying expanded capability for the RAAFCOL computer system. In the short term, the only solution was to revert to the manual board wargames.

RAAF Staff College - A More Successful Application

In 1989, RAAF Staff College staff partially automated the PROMETHEUS air defence wargame, primarily to relieve the instructional staff of the workload associated with running the manual version, which has been played by each course for some years.

ADFA cadets in their final year of computer studies assisted the Staff College Computer Training System Manager (CSTM) to automate PROMETHEUS. The CTSM was a senior Army Education Officer, who had programming skills and wargaming skills, having been on the staff of the Army War Games Centre.

During its first use, on the 1990 course, the Staff College wargame suffered similar software and hardware problems to its RAAFCOL counterparts. However, the presence on staff of the leader of the development team enabled Staff College to persevere with the automated version and it should work well by the time the 1991 course needs it.

LESSONS LEARNT

The initial problems encountered in the attempt to include wargaming in the RAAFCOL and RAAFSC curricula highlighted several critical issues, which are among those addressed by the RAAF training philosophy and the RAAF CBT policy. The problems experienced can all be attributed to a failure to approach the project systematically. The following issues were raised.

Choice of Medium. In the RAAFCOL case, automation was not really necessary and actually generated more work and delays than would the development and implementation of a manual wargame, including:

a. less 'user friendliness', due to the limitations of the software and hardware;

b. more time consuming, as disproportionate game time was wasted 'punching in' the data for each move (double handling of the manually generated plans);

c. more difficulty conducting the game and the post game debriefs, as staff did not fully understand how the game system worked (it was 'locked away' in the software that was incomprehensible to them); and

d. less flexibility, in that the staff were unable to amend the game as they thought of ways of improving it, as none was a computer programmer.

Co-ordination. The RAAFCOL project suffered from lack of co- ordination, due to the geographic dispertion of the key development personnel (the team leader being in Canberra and the programmers in Melbourne) and the user unit having little involvement in the development.

Costing and Resourcing. The projects turned out to be under resourced in the following important areas:

a. programmer time, for testing, fault finding and fault correction of the program, before implementation;

b. staff training time, to ensure that staff were able to conduct the wargame effectively;

c. hardware capacity, as the unit computer systems (really only word processing systems) lacked the 'number crunching' power power to run the wargames smoothly; and

d. ongoing software support (in the RAAFCOL case), to amend (correct and upgrade) the program, in light of results of post-implementation evaluation and validation.

CONCLUSION

The RAAFCOL and RAAFSC experiences proved the value of the systematic approach and the danger of 'short cuts'. Any wargaming project that is not managed in accordance with the principles of the systems approach will probably falter and waste

resources, rather than save them. Any automated wargame project should be managed in accordance with the RAAF policy on CBT.

The most important 'lesson' is that automation is not always necessary or even desirable. Manual wargames work.

ENDNOTES

1. Richter, Alan, 'Board Games for Managers', in Training & Development Journal, July 1990, pp 95-97.

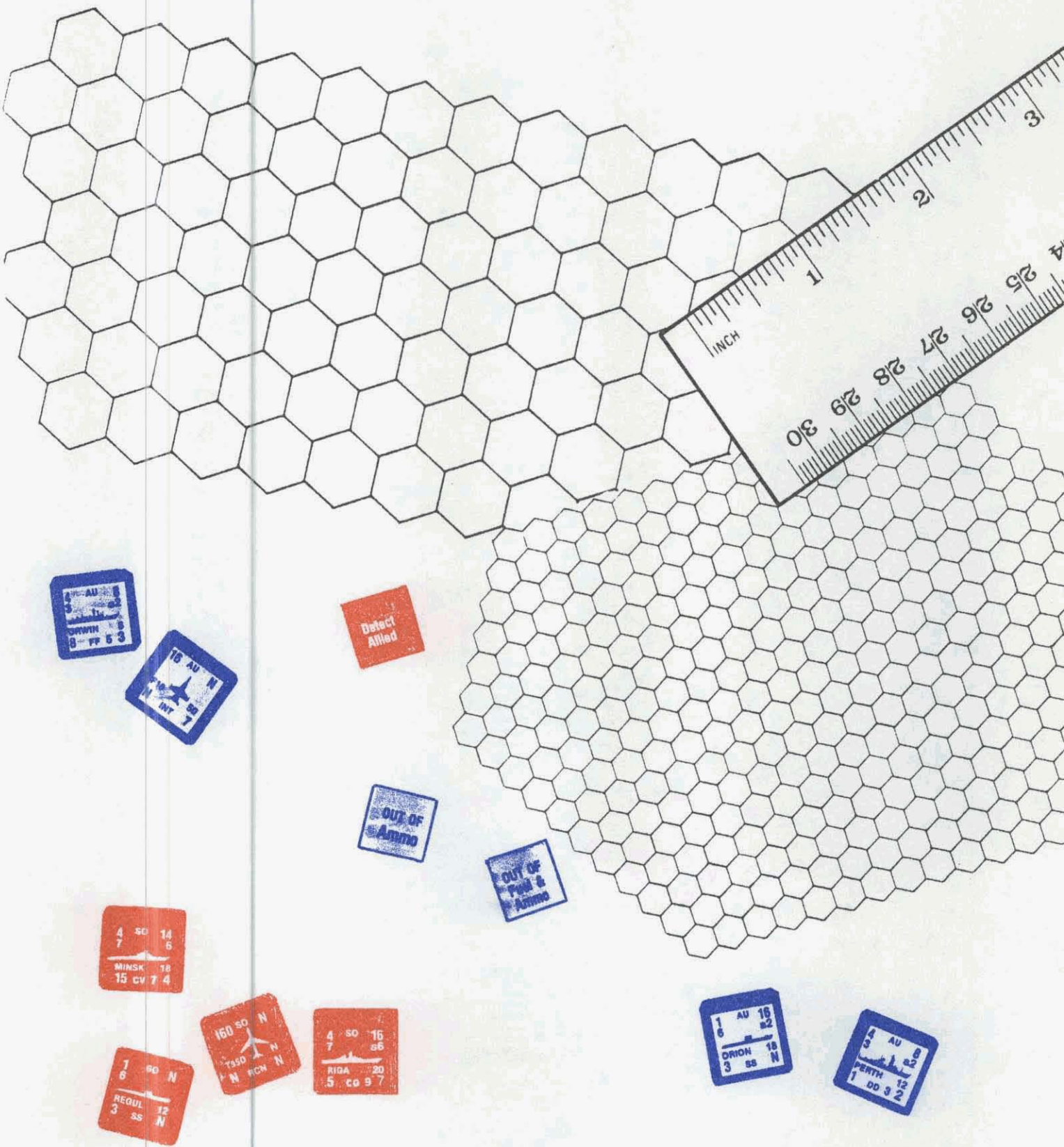
2. DI(AF)AAP 2002.001, Chapter 1.

3. DI(AF)AAP 2002.001, Chapter 1, para 101.

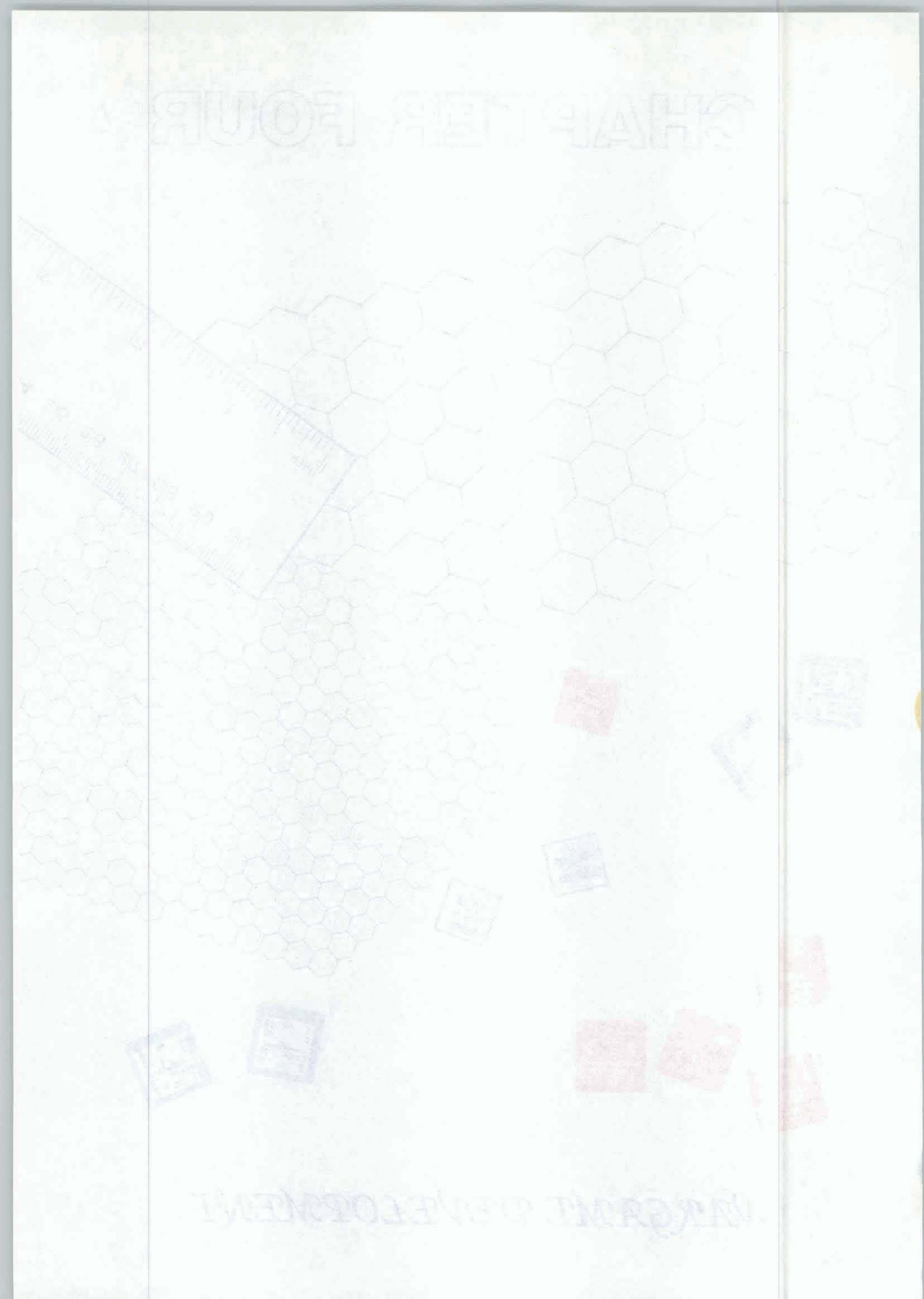
4. DI(AF)AAP 2002.001, Chapter 1, para 110.

5. DI(AF)AAP 2002.001, Chapter 2, para 219.

CHAPTER FOUR



WARGAME DEVELOPMENT



WARGAME DEVELOPMENT

'The essence of gaming is problem solving in context. The context is usually a set of rules.'
William Jones,
RAND Corporation, 1985

INTRODUCTION

Once it has been established that a wargame is the preferred solution for a training need, a process must be set in motion to develop that wargame. This chapter will cover the essential elements of the wargame development process and wargame documentation requirements.

The criteria for deciding whether the optimal solution is the development of a new wargame 'from scratch', or the adaptation or modification of one or more existing wargames will also be explored.

Considerations unique to automated wargames are also explained.

THE WARGAME DEVELOPMENT PROCESS

The following guidelines apply to the development of any wargame, irrespective of the type of game or degree of automation. They are based on the experience gained developing and implementing educational air power wargames at RAAF Command and Staff College and RAAF College in 1989/90. The principal factors to consider in wargame development are as follows.

The Objective of the Wargame

The objective of a wargame will, to a large extent, determine the type of game that is developed. If the objective is to give senior commanders practise at decision-making in a geopolitical strategic setting, a broad Mil/Pol game is the likely outcome. If the objective is to compare the effectiveness of two similar weapon systems in a specific tactical scenario, a narrower, statistically oriented analytical game is more suitable.

The objective must be clearly stated and understood by all involved in the development process. A wargame should be designed to satisfy no more than one objective. Attempts to design wargames to satisfy multiple or unclear objectives usually fail. They become unwieldy, with contradictory features and prohibitively complex alternate rules. Such complexity becomes too confusing for participants.

Development Team Composition

The wargame development team must include an experienced wargame designer (fully aware of sponsor/user requirements and familiar with the wargame types appropriate to the requirement) and a representative of the ultimate user of the wargame (who must know the user's objective, resources and organisation).

The ultimate product of the team's efforts is meant to be a wargame; not a computer program, intelligence appreciation or map exercise (all of which are only components). Therefore, the team leader should be the wargamer.

The wargame development team may also include operators (warriors), intelligence analysts, staff officers, training specialists, graphic artists, cartographers and computer programmers, as appropriate to the nature of the wargame being developed.

Operators. The operators (warriors) must be familiar with the type(s) of operation(s) to be simulated in the wargame, the SOPs of friendly forces involved and the performance/effect of relevant friendly forces' weapons and sensors.

Intelligence Analysts. The intelligence analysts are there to provide assessments of the enemy's probable objectives, priorities, strategy and tactics. Assessments of the intentions and capabilities of third parties (neutrals) may also be relevant.

They may also provide valid data on enemy force SOPs, the performance/effect of enemy weapons and relevant background information (geographic, economic, technical and political).

Staff Officers. Staff officers familiar with the workings of any command, control and communications, headquarters or staff functions/procedures being simulated in the wargame are obviously necessary to ensure faithful simulation.

Training Specialists. If the wargame is for training purposes (as opposed to analysis), training specialists familiar with RAAF training philosophy should be involved in the development (at least in an advisory capacity or as a step in the approval process at Command level).

Graphic Artists. High quality graphics contribute greatly to the 'professional' finish and credibility of a wargame. Therefore, 'professional' graphic artists are usually worth the investment.

Cartographers. Unless the playing surface is to be a standard air navigation chart or Army survey map, cartographers will be needed to produce quality wargame maps. Poor quality, illegible maps will seriously compromise wargame playability and credibility.

Computer Programmers. If full or partial automation is intended, programmers will be required to develop the software.

Sponsor Involvement

The most elegant, innovative wargame ever developed is useless if it doesn't do what the user wants. If not given clear, detailed specifications, wargame designers have a tendency to 'gold plate' their designs and create the kind of wargame that they always wanted to play, which will not necessarily be what the sponsor needs.

The sponsor of the wargame (usually the initial or principal user) must specify the requirement, in as much detail as possible, to minimise the chance that the development team will waste time and resources designing inappropriate features or omitting appropriate ones. Once development begins, the sponsor must closely supervise the process to ensure that the features built into the game are appropriate to the user's needs.

Co-location of the development team with the user unit is highly desirable, as it enables staff at the user unit to be (or at least feel) involved in the wargame from the beginning. A wargame developed in isolation is sometimes not well received by staff at the user unit (the 'not invented here' syndrome). If staff at the user unit are involved in the development, or at least able to observe it, they will better understand the game philosophy and workings. Implementation of the wargame into the unit's routine will also be quicker and easier.

Scenario(s)

A wargame can include more than one scenario, The differences between scenarios may be subtle or significant. There may be multiple initial set ups, ORBATs, special rules (constraints) and victory conditions. The scenarios may even be set in different areas of the map. The differences will enable players to explore some 'what ifs' and compare the effects of slight variations in deployments and tactics.

In an air defence wargame set in northern Australia, the scenarios could vary many important factors, including aircraft availability (number, type), support facilities availability (bases, POL, ordnance, spares, early warning and C^3I), friendly SAM and AAA system availability, constraints (such as ROE and LOAC) and victory conditions (including acceptable friendly loss rates).

Orders of Battle (ORBATs)

The order of battle (ORBATs) of the forces in a wargame consists of more than the initial set up levels. The ORBATs also include schedules of reinforcements and replacements.

Reinforcements. Reinforcements may be regular forces that arrive as the conflict develops or activated reserve units or newly raised units, which arrive later in the conflict. The reinforcements can be made available according to a pre-set schedule or be triggered by game events (eg: an enemy advance beyond a certain point may trigger the commitment of forces from the strategic reserve).

Replacements. Replacements are reconstituted units or sub units that were withdrawn from operations after attrition or exhaustion, by the game control group or at the players' discretion and have been refitted (eg: repaired aircraft, new production aircraft, activated attrition spare aircraft, wounded personnel who have recovered)

Losses. 'Healthy' combat and support units can also be moved out of players' control according to a schedule, when triggered or as determined arbitrarily by the game control group. The units can be said to have been transferred to other theatres by higher command or political interference. Such unexpected loss of units is a realistic complicating factor that tests players' flexibility and contingency management skills.

Choice of Environment

The game environment is usually easy to determine on the basis of game objective and scenario. The environmental parameters must be clearly set as early as possible in the development process. Late changes to one or more environmental parameters can necessitate major redesigns of models and rules.

Realism

In wargaming, realism is the faithful reproduction of the 'real world' scenario being simulated, with as few 'artificial' constraints as possible. Obviously 'unrealistic' constraints will frustrate participants and undermine the credibility of the wargame.

During game design, there is always a temptation to oversimplify reality, in order to make simulation easier. Some degree of simplification (abstraction) is necessary, as the only way to fully replicate war is to go to war, but a game rule that distorts reality merely to simplify the game is always open to criticism. Wargame designers must minimise the degree of abstraction of the prime factors in a scenario, however, peripheral factors can be treated abstractly, as they are not critical to the issues or processes on which the wargame was designed to focus.

An example of an unacceptable 'artificial' constraint is an air defence wargame rule precluding fighters from operating at any base other than their home base, even in an emergency and even when other fighter-capable bases are within range. Were the defenders in such a game to lose airborne aircraft because their home base was unusable (due to enemy strikes having cratered the runway) and the game rules not allowing diversion to another base, the defenders could rightly claim that the constraint was unrealistic. Such 'artificial' constraints can invalidate a whole wargame.

In the above tactical scenario, it would be acceptable to represent political or economic factors in a simplified abstract manner, as such factors are peripheral to air defence tactics. In a military/political (strategic) game, air defence tactics could be handled abstractly or perhaps even ignored, but

political issues should be explored in as much detail and realism as possible.

When determining the degree of abstraction to introduce into each aspect of a wargame, designers must prioritise on the basis of the game objective. Ways of increasing the realism of wargames (manual or automated) are discussed at Annex H.

Playability

A crucial aspect of wargaming is playability - the ease (and speed) with which a wargame can be mastered and conducted by the normal target group of participants. This is the wargaming equivalent of the computing concept of user friendliness.

Usually in wargaming, as realism increases so too does complexity. Unfortunately, as complexity increases, playability decreases. The most 'realistic' games are often also the most complex and incur the following penalties:

a. large sets of rules that are difficult and time-consuming to master,

b. large data bases of statistics, on which game mechanics and outcomes are based, which are difficult to fully understand and manipulate;

c. complex models for resolving attrition, which are time consuming and cumbersome to use;

d. complex models for representing dynamics such as battle damage, weather and its effects, terrain and its effects, morale and other psychological factors, political and economic factors, C^3I and logistics.

The result of such penalties is a wargame that is difficult and time-consuming to learn and play. The compromise between realism and playability must be based on the judgement of sponsors and designers, tempered by the priorities set by the objective of the wargame.

Graphics

As with selling used cars, presentation is very important to wargame credibilty and acceptance. Poor quality graphics (in manuals or on map displays) create an impression of amateurism that puts players in the wrong frame of mind from the beginning. If maps or tables are hard to read or confusing, they hamper rather than assist game play.

The cost of professional graphics is easily justified in terms of their positive impact on playability. The effective use of colour, shape and symbology makes games more attractive and less daunting, thus increasing the chance that players will enjoy (and therefore learn more from) the wargaming experience.

Where there are standard military (NATO?) symbols or abbreviations, they should be used. Where there are no preset standards, convenient symbols and abbreviations should be applied consistently.

Game Testing

No complex system works perfectly the first time. Wargames, especially computer wargames, must be carefully and exhaustively tested and 'fine tuned' before use in the training environment. Commercial wargaming companies may 'test play' their products as many as 100 times, using several teams of experienced testers, before releasing them to the users (customers).

All wargame development projects must include a predetermined process for systematically testing all component models and the whole game system. Time must be allowed for testing, modification and retesting.

Just as different skills are required to design (engineer), test (test pilot) and operate (normal aircrew) aircraft, so too there are different skills involved in designing, testing and playing wargames. Those involved in testing wargames must be experienced players and designers. They should possess advanced wargaming skills. Test results are invalid if the players on one side are significantly better at wargaming than those on the other side. Victory should go to the side that used the best tactics; not to the side that 'played the system' and exploited anomalies in the rules.

Testing is the most demanding aspect of the wargaming process. There is more involved in 'test playing' a wargame than what a normal user does with a finished product. Test playing a wargame involves:

a. keeping detailed records of each interaction, for later analysis;

b. checking that there are no contradictions or omissions in the rules, tables, graphics or any other game equipment (a task analagous to proof reading a document and best left to people not involved in the design of the game);

c. experimenting with 'off beat' strategies and tactics, to ensure that there are no 'loopholes' that allow players to abuse the rules to gain unrealistic advantage (a task more likely to be comprehensively covered by separate testing teams, with a variety of approaches and temperaments); and

d. in the case of a computer wargame, ensuring that every input prompts the appropriate action (software testing).

When the wargame has been played many times, the records of each type of interaction must be analysed to ensure that the models (for attrition, battle damage, movement, weather, etc) are working as designed and there is no apparent imbalance in the game. The model parameters must be adjusted if there is a flaw or imbalance.

In a wargame intended to simulate the Battle of Britain, the RAF and Luftwaffe should obtain a range of game outcomes consistent with a balanced assessment of the historical scenario (in which either side could have won the battle). Such a wargame would be unbalanced if either side always wins, especially if victory is easy.

Implementation

Once the development team is satisfied that the wargame has no design flaws, is as realistic and playable as possible and meets the sponsor/user's objective, it is ready to use. The implementation of some well-developed wargames has been mismanaged and resources wasted because of lack of co-ordination at this crucial point.

Members of the design team must conduct a formal, structured implementation program, at the user unit. Simply delivering the wargame package and then leaving the staff at the user unit to fathom it out for themselves is a recipe for disaster.

A wargame implementation program should begin with a formal course for staff who will be involved in the conduct of the wargame, especially the umpires and support staff (plotters and keyboard operators). The course should give them an overall understanding of the philosophy and mechanics of the wargame and teach them their individual tasks in the preparation, conduct and debriefing of game play.

The formal course should be followed by as many trial/demonstration plays of the wargame as staff require to master the wargame and a formal validation and modification process. The implementation program may also involve members of the design team in early wargaming, at the user unit, in an advisory or assistant capacity.

Post Implementation Validation

The process of refining a wargame should not end when it enters use at the user unit. As the wargame is used, it should be subject to a process of validation. Feedback from the training staff and players at the user unit should be compiled. The feedback could include previously undetected flaws (found during game play), players' suggestions for improving the wargame (in terms of playability, realism or updating to maintain currency) and suggestions for new applications of the wargame (which may include meeting additional objectives at the original user unit or at new user units).

All of the above forms of feedback may necessitate some modifications to the wargame. Ideally, the original wargame development team would still be available to act on user feedback. Failing that, a new team should be formed, as and when required, to continue the process of refining and improving the wargame.

A validation timetable should be laid down when the wargame enters use at the user unit. After each play of the wargame, the debrief should include validation discussion. At scheduled times (monthly or biannually), there should be staff meetings to discuss the validity of the wargame. At scheduled times (probably annually) There should be redevelopment periods, when a development team makes any necessary modifications to the wargame.

CONSIDERATIONS UNIQUE TO AUTOMATED WARGAMES

Computers offer enormous advantages in some wargaming applications, but their misapplication can cause inordinate difficulties. The advantages and disadvantages of wargame automation are described in Chapter 2.

Wargame automation involves unique problems. In addition to the considerations common to all types of wargaming, the following unique factors require consideration in automated wargaming.

Feasibility Study

Wargame computer programs are very complex and require substantial amounts of 'capacity' in terms of memory storage and 'number crunching' speed. A common error in automated wargame development is to assume that the unit's computer system is powerful enough to cope with the wargame program.

Many RAAF units now have stand alone or networked personal computer systems, that are often used as little more than word processors, a function requiring much less capacity than wargaming. Some systems cannot run wargames at all and others are too slow. Much time and effort has been wasted in some recent RAAF wargaming projects, where the development team developed a wargame program that was beyond the capacity of the sponsor's computer.

An essential initial task for the development team is to ensure that the proposed wargame computer program is feasible. The computer hardware must have sufficient capacity and speed to run the wargame program without error or undue delays. If the existing system is inadequate, its capacity can usually be expanded.

The sponsor must be made aware of the inadequacy of the existing system and given the option to increase its capacity, use a more capable computer, settle for a simpler programme (that will 'fit' the system) or settle for a manual wargame.

User Friendliness

As the use of personal computers and word processors becomes more widespread, in the workplace and home, the general population is becoming increasingly computer literate. Computer wargame software must still be designed to be intelligible to the lowest common denominator among the normal target group for the wargame. In computer wargames, user friendliness drives playability.

A common complaint about automated wargames is that inputting the commands for movement and combat is frustratingly time-consuming. The aim of the wargame software developers must be to minimise the number and complexity of the prompts on the VDU screen and of the data inputs (finger strokes) required for game set up and play.

In a manual board wargame participants can see what is happening on the battle map. When computer software is processing moves and engagements, a blank VDU screen is uninformative and demotivating. The aim of wargame software developers must be to provide sufficient relevant information (progress reports) to participants, in the form of location statements, situation reports, contact reports, after action reports (listing losses, damage and units' status) and combat system serviceability reports.

Participants should be able to access such information as the rules allow, at any time. Hard copy outputs should also be available.

Computer Generated Graphics

A paper map (board, table or wall mounted) can cover a huge area in great detail. Participants can simultaneously examine several small areas 'up close' while others can 'stand back' and get 'the big picture'. In a northern Australian scenario, one player can examine the deployment of Rapier batteries around RAAF Tindal, while another plots an air strike approaching RAAF Curtin from the north east and a third player views the broad sweep of the continent and the approaches out to 1,000 kilometers and ponders the strategic situation.

Very expensive technology (million dollar mainframe computers, batteries of $50,000 video discs and wall sized video projectors) is required to match the flexibility and detail of relatively inexpensive paper maps. Most computer generated wargame maps are limited in flexibilty and scope by the size and resolution of the standard VDU screen. A computer generated map can only present widely separated areas (or the same area in different scales) by presenting one area/scale at a time or by using multiple VDU screens.

Computer generated maps have the advantage of being animated and automatic. Once the orders are input to the computer, the units move and interact on the screen with no further human action. Wargames with paper maps require unit counters and manual movement and plotting, which can be very

time-consuming. It is also frustrating and wasteful to spend time inputting data to a computer and then do it all again on the paper map. There is also the potential for error, using the paper map.

When a wargame design team decides between a computer-assisted wargame (with a paper map) and a fully computerised wargame (with a computer generated map display), the flexibility and detail factors must be considered. In most cases, the paper map option is adequate for the task and much more cost-effective.

Software Support

Early in its implementation (and sometimes later) computer software always reveals 'bugs' that necessitate some degree of reprogramming. Any wargame that is based on 'current data' rapidly becomes outdated, unless it is constantly updated.

Manual wargames are easy for any literate person to fully understand and modify (given the time and the inclination). Computer wargames usually contain many 'hidden' assumptions and complex mathematical models, that only a software programmer, familiar with the specific computer language, can understand and modify. Therefore, a unit using a computer wargame must have access to a software programmer, familiar with the computer language used in the wargame.

To relieve participants from the tedium and time wastage involved in inputting orders to the computer, it is usually cost effective and convenient for units with extensive, ongoing computer wargaming activities to also have access to trained (fast) keyboard operators, to assist game participants.

WARGAME DOCUMENTATION REQUIREMENTS

The documentation required in support of any wargame, manual or automated, includes:

a. game rules,

b. background information (including philosophy underlying the wargame, data on the forces and combat environment being simulated and historical background)

c. supporting charts, tables and maps; and

d. records of play.

Types of Rules

Every game has rules to govern players' conduct. Wargames require at least five sets or types of rules. These are objective rules, knowledge rules, execution rules, movement rules and combat rules.[1] There is often a need for other rules, such as logistics rules.

Objective Rules

Objective rules (often referred to as victory conditions) state the performance required of players to meet the objectives of the wargame (and win). Objective rules set the standard against which player performance is judged.

All sides in a wargame (there may be more than two) need not have the same objective. In the Battle of Britain, the German objective was the destruction of RAF Fighter Command as an effective air defence force (to enable the Luftwaffe to establish control of the air over south east England and the channel, as a precondition for invasion). The British objective was to preserve Fighter Command and maintain control of the air. The destruction of the Luftwaffe was neither possible nor necessary and Britain had no chance of invading Germany. During the US strategic bombing campaign against Germany (1943-45), the USAAF objective was to destroy key war industries and disrupt Germany's capacity to wage war. The Luftwaffe objective was to destroy USAAF bombers in sufficient numbers to either force the USAAF to stop or limit the bomb damage to acceptable levels.

Knowledge Rules

Knowledge rules state how much information will be made available to players before and during the wargame. In an open wargame, players know everything about enemy order of battle, combat capability, deployments, objectives and tactical, operational and strategic options. This is the so-called 'God's eye' view. In a closed wargame, the information available to players in limited. Players may be given no information, patchy information or even false information about the enemy.

Closed wargames are more realistic. Wargames designed to exercise intelligence gathering and interpretation are tightly closed.

Execution Rules

Execution rules define the command and control arrangements in the wargame. Command and control arrangements can be very complex and poor arrangements are confusing and counterproductive.

In the simplest case, a player may directly control all elements of the forces under command (on his side), thus determining all tactics. However, a player may act as the high level operational commander, but devolve tactical control to players (or the umpires) who perform the roles of subordinate commanders. In that case, orders have to be passed through the umpires or through other players, who interpret them and then move the force elements and actually fight the battle. Such wargaming can reveal flaws in command and control arrangements and communications problems between command echelons.

Movement Rules

Movement rules specify how and when units may be moved. Movement parameters include speed, range and endurance. Many factors can enhance or retard movement.

The mobility of a combat unit (be it a mobile SAM battery or an individual F/A-18) can be enhanced by mechanical surface transport (eg: cross country, road, rail), airlift or sealift, increased fuel load (at the expense of payload), underway replenishment (including AAR) and favourable environmental factors (eg: tail winds).

A combat unit's mobility can be retarded by a logistics shortfall (eg: fuel shortage), battle damage (or any other sort of damage), unfavourable environmental factors (eg: storms, floods, blazing oil rigs or huge oil slicks), terrain barriers (such as mountain ranges and which can even affect air operations), enemy action/influence (eg: the requirement to divert around areas dominated by the enemy or where the enemy has deployed area denial weapons such as mines, or active barrier defences such as SAM belts) and other factors associated with the 'fog of war' (such as a strike force failing to RV with AAR tankers due to confusion or navigation error).

Movement rules should also include 'stacking' limits, which state how many units may be placed in an area, during a game turn. Five squadrons of fighter bombers cannot all operate out of RAAF Townsville; neither can they all simultaneously attack a pontoon bridge in a narrow valley with restricted ingress points. Air traffic control realities should also impact. Stacking limits specify realistic spatial parameters, such as the number of aircraft that can reasonably fit into a given volume of airspace over a given time.

Combat Rules

Combat rules define how units in contact can engage in combat and how the results will be determined. Results may include:

a. casualties (attrition),

b. battle damage (and assoiated degradation of mission capability),

c. failure to reach, take or hold an objective/asset/target; and

d. the requirement to 'give ground', retreat or return to base.

Attrition is the hardest real world phenomenon to simulate credibly. Simple attrition models rely on random number generation alone (the Monte Carlo technique). More realistic results can be achieved with complex formulae, such as variations of the Lanchester equations (explained at Annex I).

As the odds increase in your favour, it is reasonable to expect that you will sustain fewer casualties and inflict more on the enemy. There should be more chance of favourable attrition ratios at odds of 5:1 than at even odds. All attrition models should include a weighting that takes this factor into account. However, at some point the law of diminishing returns must apply, as only so many platforms can engage an enemy unit at a time.

In many scenarios defending ground forces gain an inherent advantage by being 'dug in' (in fortified positions). There should be another weighting, in favour of the defender. A common convention in this respect is that odds of three to one (in the attacker's favour) are required to get the same spread of combat outcomes against a 'dug in' force as would be expected in an 'encounter battle' (neither side 'dug in') at even odds.

Complex attrition models can be used in manual games by the simple expedient of a combat resolution table and dice. Examples of effective commercial wargame combat resolution tables are at Annex C. Modifiers can introduce such factors as:

a. force multipliers (AWACS, EW, PGMs), and

b. the advantages confered by terrain masking, such as heavy foliage, field fortifications (trenches, bunkers) or obscuring line of sight and line of fire.

Logistics Rules

Many simple wargames unrealistically assume unlimited and perfect logistics support. In the real world, units experience supply problems, especially during periods of intensive operations. The outcome of battle is often decided by logistics. Logistics rules introduce real world resource limits to wargaming and force players to perform resource management.

Complex logistics models can be built into computer-assisted wargames, but even manual wargames can include logistics factors. Logistics rosters can be drawn up before a play with boxes for each weapon (bomb, missile or drum of cannon rounds) and each aircraft load of POL in storage at each base. When missions are flown, ordnance and POL boxes can be marked off (by the umpire) as they are expended. Such a simple manual system can provide a reasonably realistic simulation of resource management.

WARGAME DOCUMENTATION CONVENTIONS

All games (even simple ones like 'Snakes and Ladders") must have written rules, otherwise new players cannot learn how to play the game and disputes over interpretations of the rules cannot be resolved. Wargames need detailed, comprehensive rulebooks. Given the importance of the post game debrief to the learning process, wargames also need to include a system for keeping detailed records of play.

Wargame Rulebooks

In an open wargame, all the rules may be made known to all participants, so only one rulebook is needed. The only reason to withold information (eg: umpires' instructions for game management) would be that players may be distracted by the unnecssary detail. In such a case, a separate umpires' handbook may be convenient.

In a closed wargame, umpires and players have very different degrees of 'need to know'. Umpires must know everything about the wargame, but the information made available to the players is limited. Therefore, several handbooks (containing some common and some unique information) are required for closed wargaming:

a. friendly forces handbook, containing all information available to the friendly (BLUE) forces;

b. enemy forces handbook, containing all the information available to the enemy (RED) forces;

c. umpires' handbook, containing:

(1) all the information made available to the players,

(2) instructions on how to set up, play and debrief the wargame, and

(3) notes to help anticipate and solve problems in game play; and

d. background information handbook, containing information of interest to players, but not essential to game play, including historical background, pictures and diagrams of weapons and battlefields and helpful hints.

A common convention for wargaming rules is colour coding, based on the standard wargaming colours, which helps avoid confusion. The handbooks would be colour coded as follows:

a. BLUE for the friendly forces handbook,

b. RED (or pink) for the enemy forces handbook,

c. YELLOW for the umpires' handbook, and

d. WHITE for the background information handbook.

Records of Play

Detailed, structured, umpire-led debriefs are an important part of the wargame learning process. Except in the case of a very simple game, detailed debriefing is impossible without detailed records of play.

The exact nature of the records depends on the nature of the wargame and the objective. Commonly, records of play will include:

a. exactly where each unit began and ended, each turn;

b. exactly how and where each unit moved, each turn;

c. units destroyed in each engagement;

d. units damaged in each engagement (and the nature of the damage);

e. significant events during the game, such as:

(1) weather conditions,

(2) reinforcement, replacement and repair schedules,

(3) serviceability rates;

(4) command, control and communications problems and/or errors; and

(5) logistics problems and/or errors.

Such records can be made during the play of manual wargames, using standardised forms, but computer assistance makes it easier. The software of a computer wargame can include a 'post processor', which converts the raw data of game play into a more usable form. The data can be presented in ordered groupings (by activity, function or location), charts, graphs or tables, thus making debriefing easier.

NEW GAME OR MODIFIED GAME?

The development of a wargame 'from scratch' is very expensive and time-consuming.[2] There are significant potential savings in the simple expedient of adapting an existing wargame to meet a new need, but there can also be drawbacks.

The major US and NATO wargaming organisations concentrate their efforts on high intensity/level conflicts in the northern hemisphere. The US military has begun to develop wargames simulating low intensity conflict (LIC), which to the Americans appears to include operations such as Grenada and Panama (perhaps even some battles and campaigns in the Vietnam War). Currently, the US and NATO armed forces have no wargames designed for the types of contingency (in the kinds of environment) of direct interest to Australia.

Most hobby wargamers tend to concentrate their gaming on the great historical campaigns (eg: Alexander, Caesar, Napoleon and the World Wars) and the areas most likely to be the scene of

major future conflicts (eg: NATO Central Front, US Pacific, Atlantic and Mediterranean fleets). There is not much of a global market for obscure areas where exciting large scale operations are unlikely, such as Australia's area of immediate interest. Consequently, there are no commercially available wargames simulating Australian strategic problems and contingencies. Of course, many companies and individuals in the wargaming industry are ready, willing and able to design and produce such wargames - for a price!

Professional military wargaming simulates warfare in two broad time frames. It is set in either the historical period, focussing on notable campaigns and battles, which are simulated for educational purposes (eg: to draw lessons on the effective application of air power in specific contexts) or the contemporary period (including near future), focussing on any of the many issues explored by wargaming for educational, training or analytical purposes.

Historical Wargaming for Educational Purposes

There are many worthwhile commercial wargames on the market that simulate various aspects of air warfare. Every aspect of air power mentioned in the current RAAF Air Power Manual can be simulated to some extent using commercial games. A representative cross section of appropriate wargames available in 1991 is listed in Annex K.

A RAAF training unit, such as RAAFCOL (OTS or BSS), can use these wargames (with little amendment) in a general air power education programme. RAAFCOL has actually adapted two manual commercial games, for the air power education component of the Basic Staff Course. The games simulate the Battle of Britain (based on a one-sided board game) and the USAAF bombing campaign against Germany during 1943-45 (based on a two sided board game).

The modifications required to adapt the commercial games to meet RAAFCOL needs were:

a. automating (computer assistance only) both wargames, to simplify game play/umpiring and facilitate debriefing by wargaming novices;

b. fabricating simplified, greatly enlarged wall maps and magnetic unit counters, to facilitate play by teams of three or four students, rather than individuals;

c. converting the one-sided game to two-sided configuration; and

d. some changes of detail to simplify and speed play.

Adapting existing commercial wargames was a much quicker, easier (therefore cheaper) way to meet the RAAFCOL need for simple historical educational wargames than developing a wargame 'from scratch'. The existing games were based on well-researched

data and included well-tested models (for combat resolution, movement, etc). The adaptation of existing wargames obviated the need for many man-months of research, calculation and experimentation, by an experienced design team.

The wargaming project team at ADFWC is currently developing their first operational level joint warfare game. They investigated commercial wargames and decided to adapt some of the movement, combat and outcome models used in those games.

CONCLUSION

The effectiveness and efficiency of wargame development projects revolves around:

a. a firm, clear, simple objective;

b. balanced development team composition, with maximum sponsor and user involvement;

c. a formal strategy for game development, testing, implementation and post implementation evaluation and maintenance;

d. systematic selection of scenario(s), ORBATs and game environment; and

e. an acceptable trade off between realism and playability.

Wargame documentation must be comprehensive. All RAAF developed wargames should be documented in a standard manner.

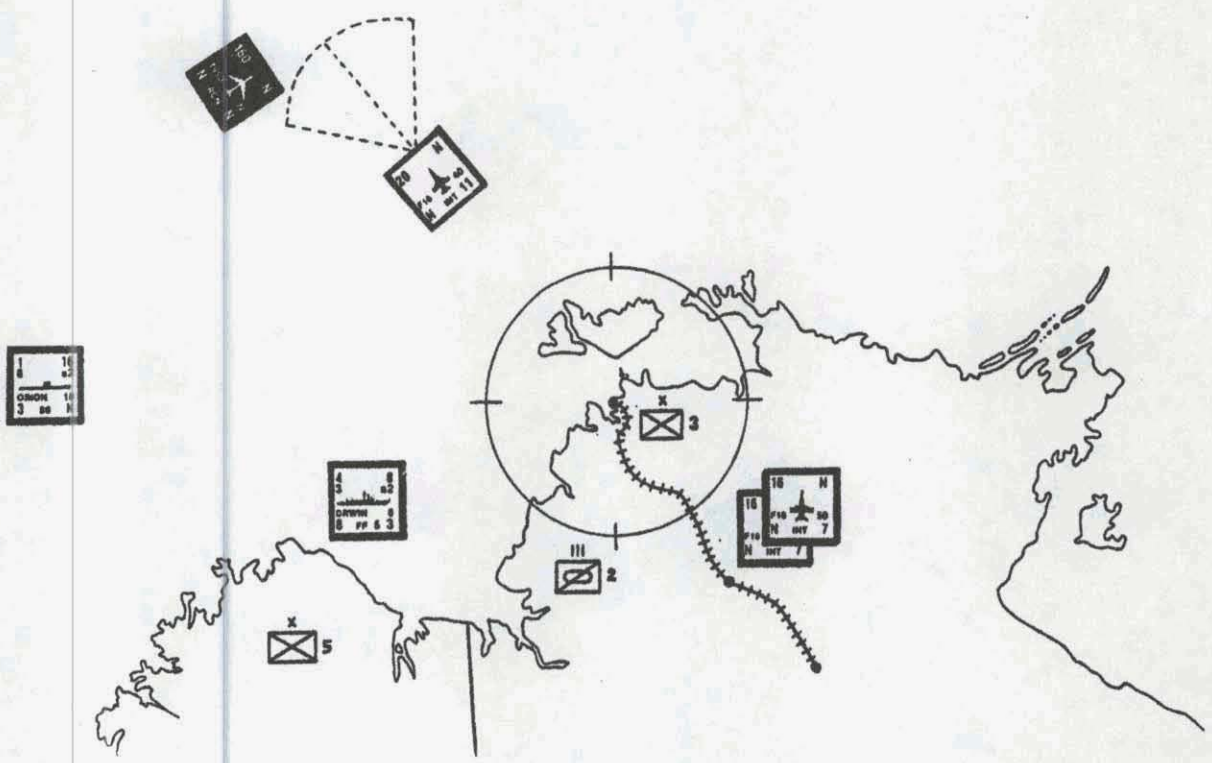
The development of a wargame 'from scratch' is a time consuming, manpower intensive process. Many RAAF training and education wargaming requirements can be adequately met by adapting component models used in commercial wargames.

ENDNOTES

1. Snyder, Frank, 'What is a Wargame?', in Naval War College Review, Autumn 1990, pp 47-54.

2. When RAAFSC sought quotes for the automation of the existing PROMETHEUS wargame (a fairly simple two day real time game), the quotes were around $200,000.

CHAPTER FIVE



WARGAMING FOR THE RAAF

WARGAMING FOR THE RAAF

INTRODUCTION

Previous chapters have explained the nature and history of wargaming and the methods of developing and implementing it in the military environment. This chapter will examine the ways that the RAAF can best exploit the potential of wargaming, in the current constrained financial climate.

This chapter will describe useful applications for wargaming in the RAAF, types of wargames most useful to the RAAF and options for creating an organisation to co-ordinate RAAF wargaming and finding or generating wargaming expertise within the RAAF.

APPLICATIONS FOR WARGAMING IN THE RAAF

Useful applications of wargaming in the RAAF include research, development and evaluation (of doctrine, strategy, tactics, force structure, weapon systems, preparedness and operational plans) and education and training (including air power awareness education, staff officer training and tactical operational training). Wargaming is a relatively cheap means of studying problems and experimenting with solutions in these important areas.

WARGAMING TO DEVELOP DOCTRINE

In the age of machine warfare, military doctrine has tended to be driven by technology. In 1914, the doctrine of mobile unmechanised warfare was invalidated by 50 year old technology (machine guns, quick-firing rifled artillery and barbed wire), which imposed the stalemate in the trenches. In 1915/16, technology provided a solution to the problem, in the form of highly mobile (tracked), well-protected (armoured), assault vehicles driven by internal combustion engines. Such a weapon system had been first proposed and rejected years earlier.[1] It took doctrine another 25 years to catch up to the technology embodied in the tank. The story of the development of air power doctrine is depressingly similar.

The new RAAF Air Power Manual was always intended to be the first step in an ongoing process of informed professional debate, leading to the refinement and widespread awareness of RAAF air power doctrine. In the 1930s, the German armed forces needed to develop new doctrines and they used a combination of the traditional staff process, wargaming and field exercises.

The theories of mobile (mechanised) land warfare and air power, developed after World War 1, had to be tested and 'proven' in large scale field exercises. However, Germany's resources

were severely limited and exercises were expensive (and created diplomatic problems with sensitive neighbours). Traditional wargaming was an economical means of experimenting with competing ideas and emerging technologies, to determine which were impractical and which were promising enough to persevere with. The process led to Luftwaffe's rejection of strategic air bombardment, in favour of control of the air and support for surface forces.

Wargaming was an important methodology in the process of developing the elements of Germany's spectacularly effective Blitzkrieg doctrine, including joint service (army/air force) co-operation and intensive offensive operations, with emphasis on mobility, tempo and the indirect approach.[2]

The Germans were only able to use wargaming in their doctrine development process because the technique was one with which they were familiar and comfortable. They had over a century of experience with wargaming - it was part of their military culture. The RAAF currently lacks the familiarity with (and trust in) wargames, at all levels from tactical to grand strategic.

The development of air power doctrine via wargaming may be a medium to long term goal, to be pursued when the RAAF has a more mature, experienced wargaming community. It took the Army many years to get to its present state of wargaming capability.

WARGAMING TO DEVELOP STRATEGY

In developing strategy, especially grand strategy, planners must consider many non-military factors, including economic, social, psychological and political (human) factors. The Germans were keenly aware of this, hence von Manstein's idea to involve senior officers of the Foreign Office (and various government economic planning authorities) in Mil/Pol gaming in the 1920s, when an emaciated, treaty-limited, financially strapped German war machine had to prepare for possible conflict with a relatively powerful and aggressive Poland. German operations were sure to be severely constrained.

Today, the ADF must prepare for complex contingencies in the region. Political and economic factors, surprisingly similar to some of those facing inter war Germany, will impact severely on the military in many of the credible contingencies. The involvement of senior politicians and public servants in HQADF and Air Command Mil/Pol gaming would serve a dual purpose. It would give commanders and planners a better idea of the nature of non-military constraints within which they may have to operate and give the politicians and public servants an appreciation of the military realities and perhaps encourage them to develop more realistic attitudes and policies. The Americans have certainly followed this line of thought since the 1950s.

Mil/Pol gaming is the most abstract and subjective form of the art. It is the easiest to develop and conduct and always

raises different issues. Though it may be seen as more the prerogative of HQADF, Mil/Pol gaming has a place in the RAAF repertoire. The RAAF could develop and conduct such gaming as a means of reinforcing air power proposals and arguments and of fostering air power awareness in the highest defence circles. RAAF strategic level wargaming can also be made to 'dovetail' into any relevant HQADF wargaming.

Wargaming will always be the only politically acceptable way to prepare and practice for power projection operations beyond our shores. Our neighbours are too sensitive to the 'Big Brother' image to tolerate actual exercises in their vicinity. Mil/Pol gaming could be developed and implemented quickly and quietly. It could be conducted away from the glare of publicity and misinterpretation that can dog large exercises.

TACTICAL WARGAMING

Tactical wargaming is the form of the art most easily visualised by the layman. It is also the most complex and difficult level of warfare to simulate. Many commercial wargames are tactical combat simulations and much professional military wargaming has always been (and will probably continue to be) tactical.

By virtue of being truly three dimensional, the simulation of tactical level air warfare is the form of the art most likely to require automation.

There is scope to start with simple wargames for limited tactical training applications at squadron/wing level, with a view to building up an awareness and acceptance of gaming (from 'grass roots' level) and helping users to determine their longer term wargaming requirements. They will not know exactly what they need until they have played a few wargames and gained an understanding of the technique.

Such games could be locally developed or adapted from existing commercial manual or computer wargames or from US DoD models, as the Army has done.

WARGAMING TO DEVELOP FORCE STRUCTURE

Analysis and analytical gaming have been used extensively (especially in the US) to experiment with force structure. Since the gulf crisis began in 1980, the Pentagon has been experimenting with the concepts of joint warfare and rapid deployment. One development was the US Army's High Technology Light Division (HTLD), which was an attempt to reconcile the contradictory demands for combat units that have adequate (heavy) firepower to win the battle, but are easily air transportable (light).[3]

Wargaming helped the Americans to quantify their global airlift and sealift requirements, as it helped Admiral Doenitz quantify his U-boat requirements 50 years before. Ultimately, the US planning/wargaming/exercising process led to their development of the joint and single service force structures and SOPs that were so effective in DESERT STORM.

Similarly the combination of analysis, wargaming and exercising helped the US Navy 'prove' to the satisfaction of their political masters that the massive Nimitz class aircraft carrier was a more cost effective means of deploying air power at sea than the cheaper Sea Control Ships and other alternatives mooted in the post-Vietnam period. The funding of multi billion dollar supercarriers continues.

Given that much RAAF equipment is US sourced, there is scope to adapt existing US models for our own force structure research. The generation of quantified data can only help the RAAF to get the share of a dwindling budget that it needs.

WARGAMING FOR WEAPON SYSTEM RESEARCH, DEVELOPMENT AND EVALUATION

The spiralling cost of modern weapon systems makes the old fashioned R&D,T&E methods impractical. We simply cannot afford to test fire hundreds of missiles (at a million dollars a piece) to build up a statistically significant library of performance data. Simulation and computer extrapolation (from a few live firings) are the only affordable alternative today.

DSTO has already embarked on a series of analytical simulation and modeling projects that are likely to produce useful results soon. The projects known to exist are described in Annex K. This is a discipline that is best left to the civilian experts, with military oversight and direction. It appears to be the one area of air power oriented simulation in which Australia is not lagging behind the world.

WARGAMING TO DEVELOP AND EVALUATE PREPAREDNESS LOGISTICS WARGAMING

Much US wargaming since the 1950s has been designed to enhance or evaluate preparedness and readiness. These are topical issues in the RAAF today. Such wargaming is not available from commercial sources, which concentrate on combat simulations. US DoD models and simulations are a good starting point for the RAAF.

Exercising and testing the preparedness of the RAAF combat support (logistics) organisation is usually perceived to be a 'resource-laden' activity, which is harder to justify and fund than exercises for the combat (especially flying) elements of the RAAF. Large scale logistics preparedness exercises are usually only permitted in conjunction with operational exercises, such as the Kangaroo series.

The Kangaroo exercises are massively expensive, because of the actual involvement of so many combat elements (men and machines 'in the field'). In order to maximise the training value to those combat elements, the logistics organisation should function virtually perfectly. There is no room for realistic exercising of the logistics organisation. Realism would generate failures that would interfere with the combat force training. Just because logistics failures happen in war is no reason to have millions of dollars worth of men and machines sitting around waiting in a peacetime exercise - funds are not unlimited in peace.

Consequently, the logistics organisation (in its broadest RAAF-wide support sense) is allowed to use unrealistic measures, such as pre-positioning maintenance and administration elements and stores, sometimes months in advance and using transport assets that would probably be diverted to higher priority tasks in a real emergency.

The logistics system is also not put under any realistic combat-related strain, such as enemy action against transport links, maintenance facilities or supply dumps, with associated losses of materiel and manpower. In a real war, losses would be sustained and would necessitate:

a. a much larger casualty processing organisation, than is currently deployed (or even planned?);

b. a battle damage repair organisation;

c. the rapid location and deployment of additional personnel materiel and aircraft (attrition spares);

d. the use of the most effective (not cheapest) means of personnel and materiel movement, to overcome enemy induced breakdowns and blockages.

These things are not done in peacetime exercises (it's too expensive). So, the rare and (in terms of logistics) 'canned' Kangaroo exercises are of little value to the logistics organisation, in its efforts to improve preparedness to support the combat forces in war.

The USAF and RAF (even the Australian Army) use wargaming as a cheap tool in (combat and support) preparedness training and evaluation. Over 150 years ago, the Prussians were using wargaming as a means of preparing staff officers for the annual summer field exercises. Wargaming helped them to streamline the logistics arrangements for exercises (and combat operations). The Prussians saw wargaming as one step (between the theory and the exercises) in the process of preparing for war. The RAAF could use wargaming in the same manner. Logistics wargaming would facilitate:

a. the development and testing of the logistics organisation (element by element or as a whole):

(1) much more cheaply than through 'live' exercises alone, and therefore more often than is currently affordable,

(2) with the ability to test out many 'what ifs' and encourage junior commanders in the logistics organisation to be more innovative; and

(4) away from the glare of often embarrassing publicity that the Kangaroo exercises attract (so we could afford to learn from our mistakes - painlessly); and

b. more efficient preparation for and conduct of support for major exercises.

Several of the wargames currently conducted by the Australian Army War Gaming Centre (AWGC), particularly OPALS (described in Annex C), are suitable starting points for the RAAF logisticians to use in examining logistics wargaming. The US DoD Wargaming Catalog includes many pure logistics wargames, that simulate all levels of logistics support for all sorts of combat scenarios. There are also many US wargames that include logistics models.

Many RAAF logisticians are graduates of such courses as the USAF MSc in Logistics Management and its US Navy and RMCS (Shrivenham) counterparts and have played some of these games. They should be in a position to assess the US logistics wargames in terms of their applicability to current issues, projects and problems in RAAF logistics.

EDUCATIONAL WARGAMING FOR AIR POWER AWARENESS

The initiatives already taken in 1989/90 at RAAFCOL and RAAFC&SC provide models for the expansion of air power awareness educational wargaming. They highlight the need that has already been perceived and acted upon in the field. All that is now required is co-ordination. An integrated series of wargames could be developed for each level of the officer training scheme, as follows.

OTS. Most of the trainees at OTS have little or no background in air power theory. Simple operational/tactical level wargames would give new officers a challenging active learning experience and reinforce the existing basic air power theory content of the course. Involvement in wargaming at this initial stage of their commissioned careers would help establish an acceptance for wargaming at grass roots level. Such wargaming need be of only one or two days duration (class time).

BSC. More complex games (again one or two days of class time), focussed on more advanced air power concepts, would reinforce the air power theory in the Basic Staff Course. It

would also enhance the wargaming skills developed at OTS and help foster a RAAF 'wargaming culture'.

ESC. An operational planning exercise in the External Studies Course would give students practice (and constructive ESS staff feedback) at planning for more complex, higher level wargaming activities. Planning is an essential first stage of both wargaming and operations. The ESC exercise would build on OTS/BSC wargaming and lead in to Command and Staff Course activities.

RAFFC&SC. A realistic operational level (CPX?) game set in a credible northern Australian scenario in the Command and Staff course would be the final step in the RAAF wargaming familiarisation process. The wargaming would reinforce the air power theory and could also tie in with other elements of the course.

Higher Level Training. RAAF officers who have undergone the above multi-stage wargaming process will be well prepared for the wargaming activities likely to be conducted at Air Command and HQADF units. They will also be prepared to get the maximum benefit from wargaming activities in advanced professional education courses such as USAF Air War College. Eventually, the RAAF will have the same broad acceptance and mastery of wargaming as other services and will thus be able to get the most value out of the art.

Development. Wargames based on existing commercial board games can meet the requirements for the OITC and BSC air power awareness wargames. The integration of all the levels of air power awareness wargaming will maximise the effectiveness of the programme. Some elements above are already at least partially developed.

The computer assisted World War Two strategic bombing/air defence games being developed for EXERCISE AESCHYLUS at RAAFCOL are an effective option for the BSC component, which is currently the first exposure to wargaming that an officer would get. In a coherent multi-stage programme, beginning at OTS, they would be more suitable as the introductory module for OITC.

The ESC already includes an operational planning assignment, so all that may be needed there is a changed emphasis to integrate it into the wargaming series. The ESC staff who must assess the plans would need no special wargaming skills, as the plan for a realistic wargame would be no different to the kind of operational plan that ESC currently requires.

The PROMETHEUS air defence wargame at RAAFC&SC is already the best wargame in use in the RAAF, but may be at the wrong level of detail for the Command and Staff course. PROMETHEUS may be more suitable for BSC. A new, higher level, wargame could be developed for the Command and Staff course. Such a wargame could be evolved from PROMETHEUS. A student on the 1991 Command and Staff course chose this matter as a topic of study.

TRAINING WARGAMING FOR STAFF OFFICERS

A recent APSC proposal that the Battle Staff at Air Command use training wargaming for staff officer development has been endorsed and is being acted upon. The exact nature of the wargaming to be developed is not yet clear, but the endorsement shows that wargaming is being taken as seriously at the highest command level as it has been at training units such as RAAFCOL and RAAFSC.

A RAAF WARGAMING ORGANISATION

Major Wargaming Organisations

At the USAF Wargaming Centre (USAFWC) there are about 100 full time staff (Service and civilian). Many reservists are involved in the wargaming activities. The USAFWC is housed in a very large, modern complex and has access to the most powerful, advanced (and expensive) computers in the world.

Wargaming Organisations in Australia's Region

The Indian and Malaysian armed forces maintain relatively large and very active wargaming organisations. They use both training and analysis wargames.

The Australian Army War Games Center (AWGC) has a staff of about 20 soldiers and civilians and about a dozen reservists. The AWGC is housed in a substantial (if old) brick building next to Army Training Command. The AWGC has millions of dollars worth of computers and peripheral equipment.

A RAAF Wargaming Centre (RAAFWGC)

In the short term, the RAAF could not afford (and has not yet demonstrated the need) for a wargaming organisation as large as those of other services. The RAAF can become involved in wargaming with a much smaller initial commitment of resources. Issues that must be addressed in respect of a RAAF War Gaming Center (RAAFWGC) include:

a. roles and tasks,

b. chain of command,

c. location,

d. degree of centralisation of RAAF wargaming,

e. degree of automation of RAAF wargaming,

f. manpower,

g. facilities, and

h. time scale.

Roles and Tasks. The Army has set simple, achievable roles and tasks for its War Games Centre and they translate well to RAAF needs.[4] The roles of the RAAFWGC should be to:

a. oversee the research, design, development, testing, implementation and conduct of all wargaming in the RAAF,

b. foster wargaming skills in the RAAF,

c. maintain a catalogue of RAAF wargames,

d. act as the RAAF point of contact for wargaming, and

e. maintain contact with other professional wargaming organisations in Australia and overseas, to facilitate collaboration and obviate duplication of effort.

Chain of Command and Location. The nature of the wargaming that will be conducted (training and educational, analytical or operationally oriented) will dictate where a RAAF Wargaming Centre (RAAFWGC) should be located. It could be co-located with the Air Power Studies Centre (reporting directly to DOCAS), Air Headquarters (reporting to either the Chief of Staff or the Air Commander) or Headquarters Training Command (in a similar manner to the Army War Games Centre).

Decentralised Wargaming. The minimum permanent establishment for the RAAFWGC would be one; a wargame designer, with administrative support from a nearby unit (as is the case for APSC). The RAAFWGC could get specialist support, including wargame testers, computer programmers, graphic artists and relevant operational and intelligence experts, attached in to form project teams as required to satisfy user requests and tasking.

Automated Wargaming. If automated wargaming were seen as the preferred type of wargaming for the RAAF, a computer programmer would be a necessary addition to the RAAFWGC establishment. The number and category of officers posted to the RAAFWGC would depend on the tasking workload, which in turn depends on user demand. The RAAFWGC could grow with the demand, as has APSC.

Facilities. If the RAAF were to adopt the concept of decentralisation, where simple, user friendly wargames are made available for user units to use in situ, the RAAFWGC would require only modest office accommodation. The RAAFWGC could be located on any RAAF base with space (eg: RAAF Amberley). Computer support could be limited to desk top PCs, with some access to larger systems at nearby units, when wargame programs are being developed and tested.

RAAF WARGAMERS - SOURCES OF EXPERTISE

As with any skill, there are only two structured ways to learn the skills of professional military wargaming - formal training (at a tertiary education institution) or on-the-job training (at a military wargaming centre).

The only other source is the civilian community, including wargame companies and amateur hobby wargamers.

Formal Training

In all the free world, there appears to be no such thing as a formal course in the art of wargaming. The professional wargaming community is very small - about 1,000 in the US and a similar number in the rest of the free world (the scale of Soviet and Red Chinese wargaming is unclear). Such a tiny discipline does not create an economically viable demand for formal training.

However, there are courses in various mathematics disciplines (such as statistics and probability) and operations research and analysis, all of which teach skills that are useful in wargaming design, development and testing. Even military history is provides a useful background for wargaming.

The US, British and Australian Services send relatively small numbers of officers to institutions such as the USAF Institute of Technology (USAFIT), the US Naval Post Graduate School (NPGS) and the MOD UK Royal Military College of Science (RMCS) for post-graduate studies in military operations research and analysis . Some graduates of such training are subsequently posted to those services' wargaming centres, mainly into the research and development cells, where the wargames are created.

The RAAF also sends officers to the USAFIT, NPGS and RMCS courses. An officer so trained would be useful in any RAAF wargaming activity.

On-the-Job Training

There is more to wargaming than analysis and mathematics. In the absence of formal training, the military relies on informal sources. On-the-job training (OJT) is the main source of wargamers in all the military wargaming centres. Experienced wargamers, who have learned mainly from their mistakes, pass on their knowledge to their peers and successors.

For the RAAF, this method could be exploited by the arrangement of exchange postings to the established military wargaming centres, in country and abroad. Another important benefit of exchanges would be to keep the RAAF abreast of the latest developments in wargaming.

Civilian Contractors

The military is traditionally mistrustful of civilian consultants and recent RAAF experience of consultancy for RAAF Q and Investment in Excellence may or may not inspire confidence. For the purposes of this thesis, 'civilians' is taken to include Defence Department civilians (eg: DSTO), civilian computer and wargame companies and hobby wargamers, including many military personnel. These sources are listed in greater detail in Annex J.

Commercial wargaming organisations have a profitable tendency to 'gold plate' any government project. The RAAF could simply abdicate all control to a contractor or consultant and accept the resultant product, at great expense. Such a product may coincidentally require a specific computer system (available only from the same source as the wargame) and will be difficult for the RAAF to maintain (run and modify as required), without ongoing vendor support. The RAAF will be using a wargame that only the vendor understands.

A more cost effective method is to maintain tight control of wargame development projects and use minimal contractor input for specific tasks. Such tasks would include computer program encoding, graphics generation (computerised or paper) or the development of specific component models or algorithms. The RAAF should maintain maximum control over its wargame development, to ensure that the final product is as close as possible to the user requirement and as easy and cheap as possible to implement and maintain.

Amateurs within the RAAF

Many officers and airmen already have wargaming skills and experience - gained through hobby wargaming. Some have acquired high levels of skill as players and umpires. A few even have design and testing skills. In the short term, these people constitute the bulk of the pool of wargamers in the RAAF.

As with any skill of use to the RAAF, those with wargaming skills should be identified by the personnel management system, so that wargaming projects can be manned with the most suitable staff. This will necessitate the development of mechanisms to identify those with wargaming skills.

In the longer term, as wargaming becomes an integral component of the Officer Education and Training scheme, the whole RAAF officer corps will become 'wargame literate'. Some officers will develop more than the basic awareness and acceptance of wargaming and the various skills and skill levels will have to be identified and managed. In an air force as small as the RAAF, wargaming will never be a category (or even stream or sub stream), so it can probably be managed in the same manner as language skills.

Airmen will be trained in wargame support roles, such as map plotting, keyboard operation, assistant umpiring and general 'gopher' duties. Those who develop wargame literacy and

familiarity with specific wargames will be preferable to total novices. Their skills can only be used efficiently if they are identified and managed.

CONCLUSION

The RAAF can and must make use of wargaming as a tool in the development of doctrine, strategy, tactics, force structure and logistics support and in the education of officers in the principles of air power.

Many specific training and operational needs that wargaming can help to satisfy have already been identified; many more will only be identified when wargaming becomes a more widely accepted and understood tool. A few limited wargaming projects have already been undertaken, as spontaneous local initiatives, in a variety of RAAF units. Some have faltered due to a lack of co-ordination and support and the others will probably suffer the same fate, unless wargaming is recognised as a valid tool and fostered throughout the RAAF.

A central co-ordinating agency (a RAAF Wargaming Centre) is needed to oversee RAAF wargaming activities, foster RAAF wargaming skills, act as a central point of contact for wargaming in the RAAF and maintain contact with wargaming organisations in other Services. The RAAF Wargaming Centre (RAAFWGC) can ensure that wargaming is only used where it is the appropriate tool, can set and monitor wargaming standards and can help allocate the as yet meagre wargaming resources available in the RAAF. However, the RAAFWGC should not dominate and prescribe all RAAF wargaming. The current decentralisation of RAAF wargaming can and should continue.

The RAAFWGC need not be a large, expensive organisation. It can begin as a single appointment in the appropriate Command Headquarters and grow with demand. Without such a focal point, RAAF wargaming cannot realise its enormous potential.

RAAF wargames need not be sophisticated, expensive hi-tech monsters, requiring huge mainframe computers and armies of technical support staff. Simple manual and PC-based wargames can satisfy many current and future requirements, quickly and economically.

Ultimately, the RAAF should aim for an integrated family of complementary wargames. Where possible, all games should use common game systems and rules - only the scenarios need change. This will make it much easier for personnel to move between wargames and for units to share and swap wargames.

The emphasis should not be just on tactical or operational level gaming, to the exclusion of strategic and staff gaming. As has been the case with the most prolific and successful users of the art (the Germans and Americans), there should be strategic level gaming, to determine a framework within which the operational and tactical gaming can be set.

There is also a need for staff gaming (HQ games), to determine the sensitivity of force elements (intelligence, transport, engineering support, etc) and to refine contingency plans. While there is a place for the simple CPX, multi-HQ games will provide more meaningful and realistic training.

Wargaming should be seen as a natural step in the process that begins with staff planning and ends in peacetime exercises or wartime operations.

The RAAF must maintain control over any wargaming development that is 'contracted out'. All RAAF wargames must be within RAAF resources, in terms of implementation, maintenance and update.

In peacetime, all RAAF activities must be aimed at developing and maintaining a credible capability to wage war, successfully. In a climate of severe financial constraint, wargaming is the only way of achieving some objectives and the most economical means of achieving others.

It's not just a game; it's training for war!

RECOMMENDATIONS

Wargaming must be endorsed by the RAAF as a valid, cost effective tool for research, planning, education and training.

A CE position should be established (within DEFAIR, HQ Air Command or HQ Training Command), the incumbent of which will be responsible for:

a. developing a RAAF policy on wargaming, that must include standard procedures for wargame development and implementation and guidelines on applications for wargaming in the RAAF;

b. fostering RAAF wargaming, by identifying RAAF personnel with wargaming skills, identifying suitable training for RAAF wargamers and convening RAAF wargaming conferences;

c. acting as a central point of contact for RAAF wargaming; and

d. maintaining contact with military and civilian wargaming organisations around the world.

To facilitate the fostering of RAAF wargaming, ACPERS-AF should initiate measures to identify serving PAF and Reserve officers and airmen with wargaming skills. Where possible, there should be a differentiation between design, testing and playing skills.

To facilitate the attitudinal change necessary to begin the process of integrating wargaming into the RAAF 'culture', DPO and DPA career managers should encourage the officers and airmen whom they manage to see wargaming as a legitimate and valuable activity, rather than a hobby of no value to the RAAF (and thus without potential for career enhancement).

To begin the process of identifying the scale of need for wargaming in the RAAF, all RAAF education, training, planning and research activities should be reviewed, to determine the applicability of wargaming to them.

ENDNOTES

1. Macksey, Kenneth, Tanks: Facts and Feats, p 21.

   In 1911, an Austrian engineer submitted a design for a large, tracked, armoured, motorised, assault vehicle. It was very similar to the tanks developed by the British, five years and millions of casualties later. The Austro-Hungarian General Staff rejected the idea, on the grounds that:

   a. wars should be fought by men (and horses) rather than machines, and

   b. the proposed vehicle was too slow to keep up with the fast moving light infantry and cavalry that would win the next war 'by Christmas!' and everyone knew that static (trench) warfare would never occur on any meaningful scale.

2. Guderian, Heinz, Panzer Leader, pp 18-46.

3. Eschel, 'The US Army's New Light Division', pp 16-22.
   Lopez, 'Fast Reaction Forces - US Style', pp 1175-1177.

4. Army War Game Center Handbook, Chapter 1, pp1-2.

The Tasks of the AWGC include:

a. enabling the practise of decision making at all levels of the army, from sub-unit to corps;

b. training HQ personnel at all levels in staff procedures;

c. testing and exercising automated command and control systems;

d. conducting operational research, including the analysis of force structures needed to counter threats at all levels of contingency;

e. testing the effect on force structure of proposed new capabilities and equipment;

f. testing contingency plans;

g. analysing tactical and logistic doctrine;

h. standardising army wargaming procedures;

i. maintaining a standard wargaming data base;

j. providing a training center for wargame development and conduct;

k. acting as the Army's point of contact for wargaming; and

l. maintaining contact with other professional wargaming centers, to enable collaboration in wargaming development.

ANNEX A

MAJOR LANDMARKS IN COMMERCIAL WARGAMING

INTRODUCTION

In the 40 years since the first commercial wargame ('Tactics') was published, designers have made many ingenious innovations that increase the realism and/or playability of manual wargames.

Listed below are the milestones in commercial wargame development. The list is by game (publisher in brackets) and is based on that appearing in Wargame Design: The History, Production and Use of Conflict Simulation Games by Berg, Dunnigan, Isby, Patrick and Simons (pp 39-40).

Many of the innovations mentioned are self explanatory, but definitions appear in the glossary of wargaming terms at the back of this thesis. The list of innovations is also a checklist of game features (simulation techniques).

THE MILESTONES

1953

Tactics (Avalon Hill - AH)

Square Grid superimposed on game map to regularise movement and interaction (eg: combat). Similar to system in Kriegspiel.

Zones of Control to simulate the influence units exert on their immediate 'neighbourhood' (the surrounding grid squares).

1958

Gettysberg (AH)

First wargame based on an accurately recreated historical scenario.

Took into account which direction combat units were facing. Attacks on front, flank and rear were managed differently.

1961

Chancellorsville (AH)

Hexagonal Grid replaced Square Grid, for greater realism.

Secondary (outer) Zones of Control.

U-Boat (AH)

Semi-hidden movement (first game not totally open).

1962

Bismarck (AH)

Fully hidden movement - detection a key part of game strategy and tactics.

Two levels of play - tactical and strategic.

1964

Afrika Korps (AH)

Overrun of hopelessly outnumbered units allowed, without attacker having to halt for set piece action.

Logistics support factored in to movement and combat (inadequate logistic support = reduced mobility and firepower).

Midway (AH)

Separate air units and air rules.

1965

Guadalcanal (AH)

Units could sustain partial loss of combat power (step reduction) rather than elimination.

Each weapon had a range, beyond which it could not fire.

Defensive artillery.

1967

1914 (AH)

Semi-active Zones of Control.

Inverted and Dummy unit counters ('Fog of War').

Special counters for units with reduced strength.

Multiple combat results tables.

Attrited units could be 'refitted'.

Vietnam (Game Science - GS)

Area movement - movement from area to area, rather than hex to hex (more abstract and suited to 'Will-o-the-Wisp' guerilla operations and airmobile operations).

Confrontation (GS)

Multi-player game.

Point/linear movement.

Economic factor - production of forces.

1968

Battle of Britain (GS)

First good air warfare game.

'Brick' Grid system (variation on Hexagonal).

Different skill levels (degrees of dificulty).

Trafalgar (Roger Cormier)

First multi scenario game.

Point control of movement, in lieu of grid.

1969

Hannibal (LR)

Land combat in the same hex (previously it was from adjacent hexes).

Blitzkrieg - Module System (PP)

Modular rules.

Multi phase movement and combat.

Crete (PP)

Airborne assault.

Flying Fortress (PP)

Games (battles) could be linked for a campaign.

Secret/variable victory conditions.

1970

Kriegspiel (AH)

Geomorphic map.

Matrix combat results table.

Panzer Blitz (AH)

Line of Sight and Line of Fire for combat.

Fire-before-movement.

Leipzig (PP)

Historically evaluated leaders.

Reniassance of Infantry (PP)

Command and Control represented by Leader counters.

Morale and Panic factors.

1971

USN (Simulation Publications Inc - SPI)

Numbered hexes (eases planning and play-by-mail or remote play).

1972

Napoleon at Waterloo (SPI)

First wargame intended as an introduction to the hobby.

Flying Circus (SPI)

Air-to-air combat.

Quasi three dimensional movement.

American Revolution (SPI)

Combat results table based on strength differential of units involved.

1973

Battles of Bull Run (SPI)

Simultaneous movement (by both sides).

Sniper! (SPI)

Individual man level combat.

Fall of Rome (SPI)

First true solitaire wargame.

1974

Star Force (SPI)

Full three dimensional movement.

Non linear movement.

Bar Lev (Game Designers' Workshop - GDW)

Different map scales for Golan Heights and Sinai fronts.

Europa Series (GDW)

Linked campaigns - German invasions of Poland, Scandanavia, France, England, North Africa, the Balkans and Russia and the Allied campaigns of reconquest.

All scenarios use the same basic movement and combat models and CRTs - a 'family' of games. Mastery of one set of rules enables players to simulate any actual or possible campaign of the European war (1939-1945)

1976

Invasion America (SPI)

'Untried' inverted counters for units with no combat experience and doubts about their effectiveness.
(the human factor!)

Dixie (SPI)

Expenditure of varying amounts of 'administrative points' to undertake any action.

Terrible Swift Sword (SPI)

Ammunition suppply and casualty count.

Units could split their fire at more than one hex.

1984

Fleet Series (Victory Games)

Family of operational/tactical level naval warfare games, set in the Atlantic (2nd Fleet), Indian Ocean (5th Fleet), Mediterranean (6th Fleet) and Pacific (7th Fleet) in the 1980s. All scenarios use the same basic movement and combat models and the same CRTs. Mastery of one set of rules enables players to simulate modern naval warfare between any nations in any scenarios.

Realistic models for smart weapons (Harpoons, Tomahawks, Mk 48 torpedoes), fast and sea skimming missiles, land based and carrier air power (including CAP, AEW and EW), submarine warfare/ASW, aerial/submarine mining and mine countermeasures. Realistic reconnaissance/detection models.

Comprehensive rules and multiple combat resolution tables for each force type on force type contact:

a. air-to-air,

b. air-to-surface (and sub),

c. surface-to-air, and

d. surface-to-surface (and subsurface).

ANNEX B

AUSTRALIAN WARGAMING: 1970-1982

INTRODUCTION

This annex describes the training wargames developed during the period 1970 to 1982. It was initiated by an Combat Development requirement to gain a better understanding of those aspects of Army force structure requirements not covered by the Material Cycle. Much of the work was initiated by Mr Tom Millane, of the Army Scientific adviser's office, with considerable assistance from Central Studies Establishment (CSE).

The wargames were intended to provide a more dynamic understanding of the problems of war and be a catalyst for the development of a military data base.

The objective was to develop a series of manual wargames and later, as wargaming gained acceptance, enhance their capability and playability by introducing computer assistance. The intention was to first develop training wargames and then to develop analytical games, with a close relationship to the training games. There would be a suite of wargames with common planning rules, adjudication rules, scenarios and geographic setting, which could be modified to suit individual unit training requirements.

The games would represent activities at battalion, brigade, division and corps levels and would include logistics aspects. They would simulate headquarters staff functions (at three levels simultaneously) and combat at the tactical level.

TRAINING WARGAMES DEVELOPED AND CONDUCTED

1971

Barossa Pearl

BAROSSA PEARL is a closed two-sided Task Force/battalion level tactical training wargame, designed to exercise HQ staff in the preparation and execution of operations plans. The emphasis is on the employment and co-ordination of Task Force and battalion elements (such as artillery, armour and APC support). BAROSSA PEARL has been played at HQ 3 Brigade, but has been used mainly by 4 Training Group.

Kokoda

KOKODA is a two-sided Task Force level tactical training wargame. A BLUE Task Force (brigade) defends against a RED motor rifle regiment, which may attack along three possible axes of advance. The game provides good tactical training for the attacker and defender. KOKODA has been used mainly at the Infantry Centre, for tactics training on the regimental course.

1972

New Pin

NEW PIN is an open one-sided movements game, designed to assist instruction in the critical areas of supply movement, including terminal facilities and modes of transport. The objective of the game is to supply 5,600 tonnes per day to an island located to the north east of Australia. It was played at the Transport Centre and AJWE.

1974

Logistics Games

The Army played a series of one-sided logistics games (over a long period) to:

a. provide training for Army logistics HQs and units, and

b. introduce logistics requirements into the tactical wargames.

The games can be played as small team decision games, stand alone administrative games or in conjunction with tactical games.

Cane Toad. CANE TOAD provides instruction in the problems involved in the deployment, build up and daily maintenance of two infantry divisions and an armoured brigade, deployed from south east Australia to Queensland.

Buffalo Drive. BUFFALO DRIVE is a communications zone game that provides training in the problems involved in supporting a corps sized force in the Darwin area.

Mobile Store. MOBILE STORE is an RACT divisional regiment game to provide instruction in:

a. regimental operations,

b. regimental SOPs, and

c. transport squadron HQ activity co-ordination.

1975

Prometheus

PROMETHEUS is a closed two-sided tactical level air defence game, set in north west Australia. A small BLUE force (twelve F-18s, and some Rapier SAM units, guided by OTHR and a

few AEW Orions) defends Derby, Curtin and Learmonth against a large RED force (of Fitter and Fencer strike and EW aircraft) operating out of a nation to the north west of Australia. The game is still used at RAAF Command and Staff College, the sole user. In 1989/90 the game was automated.

WARPAC Style Enemy Lodgement (unnamed)

This game is a two sided tactical/operational level simulation of a lodgement by a Warsaw Pact equipped and configured (RED) Regiment and the effort to dislodge that force with a NATO style (BLUE) mechanised infantry force. It was used by the Director of Infantry in a study of force structure options.

1976

Distant Drum

DISTANT DRUM was a series of divisional/corps level tactical games, designed to expose small groups (three to five) to critical decision making. The ORBATs and scenarios were based on existing training exercises in the Army's Tac 3 and 5 programmes. The rules were taken from BAROSSA PEARL. The game was played at the Land Warfare Centre and the Armoured Centre.

1977

Water Buffalo

WATER BUFFALO is a division/corps level HQ staff training wargame, which includes air, naval and logistics aspects. It can be played as a land battle (with air and naval support) or as a joint wargame. WATER BUFFALO provides training in:

a. the employment of air and naval units in support of the land battle, and

b. the preparation and execution of operations and logistics plans.

WATER BUFFALO may be played employing major elements of a divisional HQ or with the operations orders and plans being generated by small player groups (five to seven). The enemy team requires about eight players. WATER BUFFALO has been played at HQ 1 Division, HQ 2 Division, Army Command and Staff College and the Army War Games Centre.

Terra Australis

TERRA AUSTRALIS is the title used for WATER BUFFALO at Army Command and Staff College and the Army War Games Centre.

Armoured Centre Training Game (unnamed)

This is a regimental level tactical/operational game designed to train Armoured Corps officers for regimental duties. It is played at the Armoured Centre.

1978

In Concert

IN CONCERT is a Task Force level Joint HQ CPX, designed to examine joint doctrine at Task Force level. It was played at HQ 3 Task Force.

Sea Lion

SEA LION was a series of one sided administrative games designed to provide instruction in road, rail and sea terminal operations, to:

a. train Terminal Regiment personnel, down to troop level,

b. test Terminal Regiment SOPs, and

c. exercise all HQs, from regimental down to troop, in terminal staff procedures.

SEA LION was played at the Army School of Transport, 10 terminal Regiment and 1 Transport Regiment.

Ocean Arrow

OCEAN ARROW is a naval task force level, tactical wargame developed for RANTACS. The game deals with over-the-horizon weapon system employment and convoy protection. It has been played at HMAS Watson and HMAS Albatross.

BatMan

The Battle Management and Strike Effectiveness War Game (BatMan) is a tactical game designed to:

a. demonstrate the effectiveness of modern surface to air and air to surface weapons, for which realistic models were developed; and

b. exercise participants in resource (attrition) management during an air/land battle.

BatMan appears to have been played a few times at the RAAF Staff College, in the late 1970s. It then suffered the same fate as most other RAAF wargames. It disappeared without trace and the current staff profess to know nothing of it. It now gathers dust in a library, somewhere in Canberra!

Water Buffalo - Airpower Aspects

A version of WATER BUFFALO was played at HQ (RAAF) Operational Command (now Air HQ) to train staff officers in the employment of air assets in support of a corps force.

1979

Water Buffalo - Seapower Aspects

Another version of WATER BUFFALO was a HQ staff game played at RAN Staff College to train officers in the employment of fleet assets.

1980

Water Buffalo - Logistics Aspects

Another version of WATER BUFFALO focussed on logistics aspects. It was played at Army Command And Staff College and the Army School of Transport to train officers in logistics procedures, planning and execution.

Pulse Monitor

PULSE MONITOR is HQ game for medical staff, to expose medical officers to the medical planning and execution processes, at corps level. It was played at the Army School of Health and by the Director General Army Health Services.

1981

Water Buffalo - Joint Warfare

A version of WATER BUFFALO was developed that combined all the features created for the earlier games that had focussed on the air. land, sea and logistics aspects. It was played at the Army Command and Staff College to train officers in the planning and execution of operations.

1982

Water Buffalo- Analytical Application

The Director General of Army Training (DGAT) sponsored the development of a general purpose analytical game, based on WATER BUFFALO. It was designed to examine all aspects of:

a. staff work,

b. force element capabilities,

c. doctrine, and

d. policy.

It also provided a series of validated scenarios to assist in special purpose studies, using wargaming techniques. Applications included an attack helicopter study and a detailed examination of the Army Development Guide.

GENERAL POINTS

In 1982, battle analysis of past wars was begun, to assist in the validation of the models used in the wargames. Similar studies have been undertaken by the US Army (Colonel T.N. Dupuy). The idea is that models developed for wargaming are applied to past battles, for which a comprehensive data base is available. The battle is played out many times and if the game outcome is usually close to the historical result, the models must be valid.

A common problem with much of the Australian wargaming of the period was that documentation tended to be incomplete when the wargames were first used and it had to 'catch up'. Incomplete documentation in wargaming entails the same problems as incomplete documentation in any other form of training and in computer programming.

CONCLUSION

The wargaming developed and conducted in Australia in the 1970-82 period covered many aspects of warfare, including:

a. air, land and maritime force element deployment;

b. all forms of transport;

c. logistics support for deployed forces;

d. operational, logistic, personnel and medical staff procedures and functions;

e. many aspects of combat at the tactical and operational levels, including:

(1) the employment and effects of many modern 'smart' weapon systems,

(2) attrition management,

(3) the application of SOPs, in combat situations, at many levels, and

(4) analysis, for doctrine development.

As was shown by the variations of WATER BUFFALO, a wargame can be designed to focus participants' activities on one aspect (eg: logistics or air operations), while the game control system manages other aspects, in the background. There was only limited use of automation in the wargames described in this annex. Those aspects that need to be simulated for realism and validity, while not being central to the objective of the wargame, can be automated to provide the necessary environment, within which the human participants can operate.

ANNEX C

AUSTRALIAN ARMY WARGAMING IN THE 1980s

INTRODUCTION

This annex describes the wargaming conducted for the Australian Army by the Army War Games Centre (AWGC), since its establishment in March 1984. The source of the information is a brochure issued by the AWGC.

The AWGC is part of the Development Branch of Army Training Command and is responsible for all wargaming in the Australian Army. All the AWGC's wargames are computer assisted or automated. The AWGC has air transportable cargo containers, custom fitted with computers and associated equipment, for easy air deployment to client battalion, brigade and division HQs around Australia. The HQ staff can thus play the CPXs in their normal operating environments. This is also a much cheaper means of conducting the wargames than having large HQ staffs go to Sydney.

The AWGC currently conducts the following wargames:

a. CANNON ROW,

b. COMBAT SIM,

c. OPALS, and

d. JANUS(T).

CANNON ROW, COMBAT SIM and OPALS were developed by the AWGC, with assistance from DSTO (ARL) and a US computer company. JANUS(T) was developed for the US Department of Defense and was acquired by the Australian Army only recently.

WARGAMES CURRENTLY IN USE AT THE ARMY WAR GAMES CENTRE

CANNON ROW

CANNON ROW is a computer assisted decision trainer designed to assist commanders to train their operations, personnel and logistics staff in decision making and staff procedures. It can drive a CPX, using three microcomputers. The game simulates weather, terrain, visibility, obstacles, indirect fire, offensive air, electronic warfare, battle casualties and equipment breakdowns.

The game uses a map table and playing pieces (manual methods) and the computers (automation) resolve combat outcomes and calculate attrition. There is thus a degree of 'double handling', in that participants must physically move the playing pieces on the map table and also input the data to the computer, to enable it to apply its models to events.

CANNON ROW is terrain and scenario independent, so each user unit can set the wargame in its local environment, for training or exercise preparation. The AWGC conducts regular short courses for CANNON ROW board controllers, so that user units can conduct the training independently. All the game hardware and software is available from the Army Training Groups in the capital cities.

COMBAT SIM

COMBAT SIM (Computerised Battle Simulation) is a fully automated battalion/brigade level procedural trainer. It consists of 10 networked microcomputer workstations, which perform the following roles:

a. higher control,

b. manoeuvre,

c. fire support (artillery),

d. air operations and air defence,

e. personnel and logistics functions, and

f. opposing (RED) forces.

The workstations have colour terminals, linked to a videodisc graphics system that enables independent panning and zooming through six scales of standard survey quality maps (from a three kilometre by four kilometre area at 1:50,000 scale to a 90 kilometre by 120 kilometre area at 1:1,000,000 scale). The digital terrain model provides three dimensional simulation, giving the capability to determine line of sight (LOS) between units. It also incorporates foliage and urban terrain into the LOS simulation.

COMBAT SIM automatically models direct and indirect fire, obstacles, offensive air (fast fixed wing), helicopters, guided munitions, visibility (linked to weather), movement (matching speed to terrain), combat adjudication and personnel and logistics functions. AWGC staff can manually (off line) manage radar detection, aural detection and electronic warfare. There are plans to add an NBC model.

The game is conducted at the user unit by AWGC staff, using the AWGC (air transportable) hardware. In 1986, the US Army selected COMBAT SIM as its primary battalion/brigade level command and control trainer.

OPALS

The Operations Personnel And Logistics Simulation (OPALS) is a computer assisted brigade/division/corps level wargame, based on Terra Australis, developed by the AWGC. OPALS is:

a. a decision trainer for staff officers, at brigade level and above;

b. a procedural trainer for staff officers, at division level and above;

c. an analysis simulation, at division level and above; and

d. a procedural trainer for specialist staff and units.

OPALS simulates the battlefield in great detail, and a variety of scales (based on standard survey maps). It uses a hexagon grid system overlay and also has an interactive video mode. The game runs in fast time, compressing a 24 hour action into two hours of play. OPALS models the following sub systems:

a. operations and combat adjudication,

b. medical and personnel,

c. transport and movement control,

d. supply,

e. recovery and repair,

f. enemy force operations,

g. enemy force maintenance, and

h. 'supporting services' (an Army euphemism for RAAF and RAN?).

JANUS(T)

JANUS(T) was developed for the US Army and, since its first use in 1987, has been adopted as the battalion level analytical simulation in the US, British, Canadian and Australian armies. JANUS(T) is one of many versions of the wargame. Each user has slowly evolved a unique version, thus defeating the initial aim of a NATO standard game. Current versions include:

a. JANUS 4 - the fourth generation CPX driver,

b. JANUS(R) - a research and evaluation tool, and

c. JANUS(T) - a combat development tool.

An improved version of the basic CPX, JANUS 5.1, is being developed. The Americans have spent millions of dollars on JANUS and will continue to develop it as a family of games.

JANUS(T) uses high resolution computer graphics and can simulate up to 198 different weapon and equipment systems and up to 1,000 combat and support units. The resolution ranges from individual infantry soldiers in an area of a few hundred square meters to whole divisions operating over hundreds of square kilometres. The game models:

a. direct and indirect fire,

b. offensive air (currently A-10 Warthog and AH-64 Apache),

c. laser guided munitions,

d. target acquisition,

e. movement, including mechanised infantry mounting and dismounting;

f. logistics, and

g. engineer capabilities (construction and demolition).

The USAF is developing a version of JANUS that will have a data base capable of supporting the simulation of close air support (CAIRS), battlefield interdiction (BAI), air superiority and (perhaps) maritime strike.. This will realise the initial objective of simulating all facets of the air/land battle.

JANUS(T) is run on an rather expensive computer system, currently a VAX 3900 minicomputer with four high resolution TEKTRONIX 4225 graphic work stations. The entire system is deployable, but requires considerable AWGC staff support to run.

JANUS(T) was programmed in FORTRAN, which is rather clumsy, compared to later generation languages, such as SIMSCRIPT, which was specifically designed for simulation applications. This makes the program difficult and expensive to maintain and update. JANUS(T) is consuming the lion's share of Army wargaming funds (eg: about one third of the AWGC's 1991 budget of $600,000).

JANUS(T) uses a NATO/WARPAC weapon system data base (for performance, pK, etc), which lacks many of the weapon systems used by the ADF (eg: Leopard AS1 tanks, uniquely Australian versions of the M113 armoured personnel carrier, UH-1H helicopter gunships, F/A-18 Hornets, F111Cs and P-3C Orions). Even the promised USAF version will lack relevance to Australian contingencies. The development of an Australian weapon system data base would be very expensive.

JANUS(T) is an excellent tactical wargame. However, above brigade level, it simply aggregates units into divisions and corps, without fully simulating the HQ staff functions at division level and above.

CONCLUSION

The wargaming capability of the AWGC is impressive and very practically oriented towards supporting Army training. The Army has taken an active interest in wargaming for decades and

invested millions in the AWGC in the 1980s. This investment is a good indication of the value of wargaming to Australia.

However, some well-informed observers have criticised the Army for focussing all its effort on a few 'high tech', high cost, automated and computer assisted wargames and the consequent abandonment the option of having many smaller manual games. The Prussians and Germans found that using a multitude of manual games (with similar rules) at all levels was effective. Some modern exponents of the art of wargaming may be too dependent on computers.

ANNEX D

GAMING VERSUS CAMPAIGN ANALYSIS

	GAMING	CAMPAIGN ANALYSIS
Objectives	Training Exploring decision making process	Quantitative insights into feasibility and critical physical factors
Event Sequence	Dynamic	Pre-ordained
Engagement Outcomes	Stochastic	Usually as expected
Learning	Few identical reruns	Rerun until balanced outcomes achieved
Interpret	Processes	Results
Players	Mainly civilian Some military advice	Military in military roles

Source: The Art of Wargaming by Peter Perla (p 286)

GAMING VERSUS EXERCISES

	GAMING	EXERCISES
Activity	Simulation of Operations	Operation of real forces
Goals	Training Explore decision processes	Training Evaluate performance
Cost	Relatively cheap	Very Expensive
Time Scale	Adjustable	Real time only
Flexibility	Anywhere, anytime (few resources)	Limit: available forces (resource constrained)
Levels of Play	Any level desired	Mainly tactical Some operational level
Players	Civilian and Military Can include highest ranks	Military only Seldom includes highest ranks
Results	Qualitative assessments of decisions	Quantitative measurement of performance

Source: The Art of Wargaming by Peter Perla (p 281)

ANNEX E

REPRESENTING THE SIMULATED ENVIRONMENT

This annex explains some aspects of the two basic elements of environmental simulation in manual wargames. Most of the points also apply to automated wargames. The elements are:

a. terrain, and

b. weather.

Wargaming conventions for standardising movement and interface in the simulated environment are also described.

Terrain

As with standard topographical survey maps, colour is the simplest means of representing terrain on wargaming maps (for significant features and vegetation on dry land or undersea). Just as standard NATO unit symbols should be used for playing pieces, so too, standard Army Survey Corps and Military Aviation map conventions and symbology should be used where possible in wargames.

Air/Land Warfare. In land and air/land warfare terrain features are crucial determinants of line of sight (LOS) and line of fire (LOF), which in turn determine the ability to detect and engage the enemy, or avoid him. Automation is not necessary for realistic LOS/LOF simulation - colour is enough.

In the commercial wargame 'Panzer Leader', several elevations represented by colour coded topography. To determine whether LOS/LOF is possible, the attacker checks the elevation of his unit and its prospective target and ensures that there is no higher feature between the two. Low level strike aircraft can use a similar technique to get the terrain masking effect and avoid detection and the attentions of enemy air defence.

Submarine Warfare & ASW. In submarine warfare and ASW, the significant undersea terrain features are thermal layers and salinity. Depth is also a factor. These can be abstracted in a manual wargame, using variable detection tables, as in the example below:

Die Roll	US / NATO SS or SSN	Soviet SS or SSN	Soviet noisy SSN	Soviet deep diving SSN
0 or less	D	D	D	D
1	D	D	D	-
2	-	D	D	-
3 to 5	-	-	D	-
6 or more	-	-	-	-

Note:

In the above submarine detection table a six sided die is used. The dice rolls can be modified if the target submarine:

a. is running near the surface,

b. is running in shallow water,

c. is running deep,

d. has just launched a weapon,

e. is running at high speed, or

f. is drifting, with minimum noise.

Air Power at Sea. Even though the ocean surface lacks terrain features to mask aircraft, the tactic of stepping down in altitude to remain below the enemy radar horizon can be seen as a form of terrain masking. This can be simulated easily.

The effective detection range of the radar (as modified by 'weather') can be calculated in hexes, for given altitudes. Associated aircraft fuel consumption/payload tradeoffs can be represented on another table and the option to step down, at the cost of lower flight profile and thus reduced range/payload can be simulated.

Weather

In wargames the term weather can be used in the broadest sense and includes:

a. precipitation (rain, sleet and snow), which can:

(1) reduce the mobility of land combat forces and their logistic support,

(2) degrade the effectiveness of aircraft sensors (and reduce aircraft range), and

(3) degrade the optical and IR sensors, on which many weapons systems rely for their accurate delivery;

b. wind, which can:

(1) reduce the endurance of men in the open (eg: ground crews at a bare/forward base, dismounted infantry) especially if it is cold or the terrain is sandy;

(2) alter aircraft performance (head/tail wind effects) and force planners to increase fuel loads or AAR RVs and/or change mission profiles and routes;

(3) reduce the accuracy of ballistic weapons (artillery projectiles, bombs and missiles), especially if it is gusty and frequently changing direction; and

(4) profoundly alter the effect of aerosol weapons (eg: NBC, napalm and fuel air explosives);

c. temperature and humidity, which can:

(1) degrade the effectiveness of any man or machine, but particularly electronics;

(2) increase the logistics effort required to keep forces in the field (eg: extra water in the desert, unusual lubricants in arctic, jungle or desert conditions); and

(3) effect the impact of NBC measures (eg: heat and humidity reduce the endurance of men in NBC suits, so forcing them to wear suits in the desert can help); and

d. other atmospheric phenomena, including:

(1) heat haze, fog, smog and cloud, which reduce visibility for target detection and engagement; and

(2) upper atmosphere ionisation, which can effect the performance of OTHR and EW (ESM, ECM and ECCM).

All the above 'weather' can be modelled simply in a manual wargame, by using tables. The area of operations can be divided into weather zones and the tables can be consulted at regular intervals (daily, hourly or for each move, interaction or engagement). Umpires can change the weather without warning. This complicates the participants planning and decision making processes and introduces the realistic frustration of seeing a good plan fail due to circumstances beyond control. Weather tables typical of commercial manual board games are shown below.

Die Roll	Weather
0 to 4	Clear
5	Squalls
6	Storms

Die Roll	Zone Affected
0	Gulf of Carpentaria
1	Cape York
2	Coral Sea
3	Torres Strait
4	Arnhem Land
5	Darwin area
6	Pilbarra region

Die Roll	JAN FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV DEC
1	S	S	M	M	C	C	C	C	M	S
2	S	M	M	C	C	C	C	C	M	S
3	S	M	C	C	C	C	C	M	F	S
4	S	M	C	C	C	C	C	M	F	S
5	S	M	C	C	C	C	M	F	S	S
6	S	M	C	C	C	C	M	F	S	S

Key:

S = snow
F = frost
M = mud

} all reduce surface (cross country) mobility (of combat & logistics units)

C = clear

Standardising Movement and Interaction

A popular form of amateur wargaming today uses miniatures to represent the forces and distances for movement and weapon range must be measured with strings or rulers. Such methods are imprecise and time consuming.

The original Kriegspiel used a square grid superimposed over the playing area (map) to standardise movement and interaction between units. This convention was effective but had the drawback that each unit's grid square had full contact/interface with four others and tenuous corner contact with four more.

The modern improvement on the square grid is the hexagonal grid, which gives equal contact with all (six) surrounding zones. The hexagonal system is also more realistic in terms of land units facing, attacking and defending in set directions (front, forward and rear flanks and rear).

High level strategic wargames do not require such precision and often use more abstract or less precise zones. One wargame has geographic zones, including Papua New Guinea, Indo China, the Mariannas and Eastern USA.

Surface warfare tends to be mainly two dimensional, though submarines and air support do participate in surface warfare and operate in the third dimension. The hexagonal grid system works for surface warfare, but air to air combat is truly three dimensional and cannot be adequately represented on a two dimensional playing surface.

Tactical air to air gaming is therefore very difficult to simulate manually. The few commercial manual wargames that attempt to simulate dogfights are rather complex, very abstract and require a powerful imagination. Realistic air to air gaming requires computer power.

ANNEX F

COMBAT RESOLUTION TABLES

Experience has shown that complex Combat Resolution Tables (CRTs) developed at great expense (using huge data bases from exhaustive laboratory and range testing and actual combat) are often not much more valid than simple CRTs developed on the basis of common sense. Adaptations of the CRTs used in commercial wargames are an adequate starting point for the RAAF.

The CRTs used in commercial board and computer wargames already integrate 'smart weapons', electronic warfare and advanced sensors into realistic combat loss ratios. The probability curves on which these CRTs are based can be shifted to the left or right to increase or decrease the odds required to achieve given loss rates, or the curves can be flattened to change the ratios. Simple trial and error, coupled with common sense and operational experience, can produce valid CRTs.

CRTs are said to be either 'bloody' (ie: many outcomes involving casualties and damage) or 'bloodless'. Bloodless CRTs have outcomes such as:

a. loss of ground or of control of a sector of airspace (retire/retreat),

b. mission aborted (return to base),

c. mission failure (firepower not successfully applied to the target), and

d. degraded mission effectiveness (only partial success).

The CRTs shown below are typical of those used in the popular, realistic commercial board wargames available in any hobby shop. An understanding of these examples of simple attrition models will enable almost anyone (even a pilot) to develop valid CRTs.

TYPICAL COMMERCIAL LAND COMBAT CRT

DIE ROLL	ODDS RATIO 1:3	1:2	1:1	2:1	3:1	4:1	5:1	6:1	7:1
-1	AE	AE	AE	AE	AH	AR	EX	NE	HX
0	AE	AE	AE	AH	AR	EX	NE	HX	DR
1	AE	AE	AH	AR	EX	NE	HX	DR	DR
2	AE	AH	AR	EX	NE	HX	DR	DR	DH
3	AH	AR	EX	NE	HX	DR	DR	DH	DE
4	AR	EX	NE	HX	DR	DR	DH	DE	DE
5	EX	NE	HX	DR	DR	DH	DE	DE	DE
6	NE	HX	DR	DR	DE	DE	DE	DE	DE
7	HX	DR	DR	DE	DE	DE	DE	DE	DE
8	DR	DR	DR	DE	DE	DE	DE	DE	DE

KEY:

AE attacker eliminated (no effect on the defender)

AR attacker retreats (no effect on the defender)

NE no effect on either side

HX half exchange (the defender loses half of his force; the attacker loses a matching amount of combat power)

DR defender retreats (no loss to the attacker)

DE defender eliminated (no loss to the attacker)

Note:

A six sided die is used. Rolls can be modified by positive or negative modifiers (eg: if the defender has anti-armour weapons a negative modifier applies to attacks by armoured units).

TYPICAL COMMERCIAL AIR COMBAT CRT

DIE ROLL	DIFFERENTIAL (Attacker : Defender)										
	-5	-4	-3	-2	-1	0	1	2	3	4	5
1	A	A	K	K	K	K	K	K	K	K	K
2	A	A	A	K	K	K	K	K	K	K	K
3	R	A	A	A	K	K	K	K	K	K	K
4	R	R	A	A	A	K	K	K	K	K	K
5	-	-	R	R	A	A	K	K	K	K	K
6	-	-	-	-	R	R	A	A	K	K	K
7	-	-	-	-	-	-	R	R	A	A	K
8	-	-	-	-	-	-	-	-	R	R	A
9	-	-	-	-	-	-	-	-	-	-	R
10	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-

Key:

A mission aborted - aircraft return to base undamaged

R mission aborted - aircraft return to base damaged

K aircraft destroyed - mission not completed

- aircraft complete mission and recover to base undamaged

Note:

A 12 sided die is used. Again, the dice rolls can be modified .

THE VG FLEET SERIES

The 'Fleet' series are operational/tactical level simulations of naval warfare in the 1980s. Airpower is treated more abstractly than surface warfare. Each combat unit (a warship or a squadron of aircraft) is rated for the number of 'hits' required to 'kill' it (eg: 9 hits kills an aircraft carrier; 2 hits kills a light frigate). A ship is damaged (reduced mobility and firepower) by hits of more than half its kill value (eg: 5 hits on an aircraft carrier).

		ATTACKER's COMBAT POWER													
DEFEND ROLL	ATTACK ROLL	1	2	3	4 to 6	7 to 9	11 to 15	16 to 20	26 to 32	33 to 40	41 to 49	50 to 59	60 to 70	71 to 82	83 or more
-8	-7	0	0	0	0	0	0	0	0	0	0	0	0	0	1
-7	-6	0	0	0	0	0	0	0	0	0	0	0	0	1	1
-6	-5	0	0	0	0	0	0	0	0	0	0	0	1	1	2
-5	-4	0	0	0	0	0	0	0	0	0	0	1	1	2	2
-4	-3	0	0	0	0	0	0	0	0	0	1	1	2	2	3
-3	-2	0	0	0	0	0	0	0	0	1	1	2	2	3	3
-2	-1	0	0	0	0	0	0	0	1	1	2	2	3	3	4
-1	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4
0	1	0	0	0	0	0	1	1	2	2	3	3	4	4	5
1	2	0	0	0	0	1	1	2	2	3	3	4	4	5	5
2	3	0	0	0	1	1	2	2	3	3	4	4	5	5	6
3	4	0	0	1	1	2	2	3	3	4	4	5	5	6	6
4	5	0	1	1	2	2	3	3	4	4	5	5	6	6	7
5	6	1	1	2	2	3	3	4	4	5	5	6	6	7	7
6	7	1	2	2	3	3	4	4	5	5	6	6	7	7	8
7	8	2	2	3	3	4	4	5	5	6	6	7	7	8	8
8	9	2	3	3	4	4	5	5	6	6	7	7	8	8	9
9	10	3	3	4	4	5	5	6	6	7	7	8	8	9	9
10	11	3	4	4	5	5	6	6	7	7	8	8	9	9	10
11	12	4	4	5	5	6	6	7	7	8	8	9	9	10	10
12+	13+	4	5	5	6	6	7	7	8	8	9	9	10	10	11

Air-to-Air Combat CRT

DIE ROLL	RATIO (ATTACKERS TO DEFENDERS) 1:5	1:4	1:3	1:2	1:1	2:1	3:1	4:1	5:1
0-	5r/0	4r/0	3r/0	2r/0	1r/0	0r/0	0/0	0/0r	0/1r
1	4r/0	3r/0	2r/0	1r/0	0r/0	0/0	0/0r	0/1r	0/2r
2	3r/0	2r/0	1r/0	0r/0	0/0	0/0r	0/1r	0/2r	0/3r
3	2r/0	1r/0	0r/0	0/0	0/0r	0/1r	0/2r	0/3r	0/4r
4	1r/0	0r/0	0/0	0/0r	0/1r	0/2r	0/3r	0/4r	0/5r
5	0r/0	0/0	0/0r	0/1r	0/2r	0/3r	0/4r	0/5r	0/6r
6	0/0	0/0r	0/1r	0/2r	0/3r	0/4r	0/5r	0/6r	0/7r
7+	0/0r	0/1r	0/2r	0/3r	0/4r	0/5r	0/6r	0/7r	0/8r

KEY:

The number to the left or each pair applies to the attacker and the number to the right applies to the defender. A squadron is halved in firepower by one hit and destroyed by two hits. At odds of 3:1 on a modified die roll of five, the attacker loses nothing and the defender takes four hits (four squadrons are halved or two are destroyed)

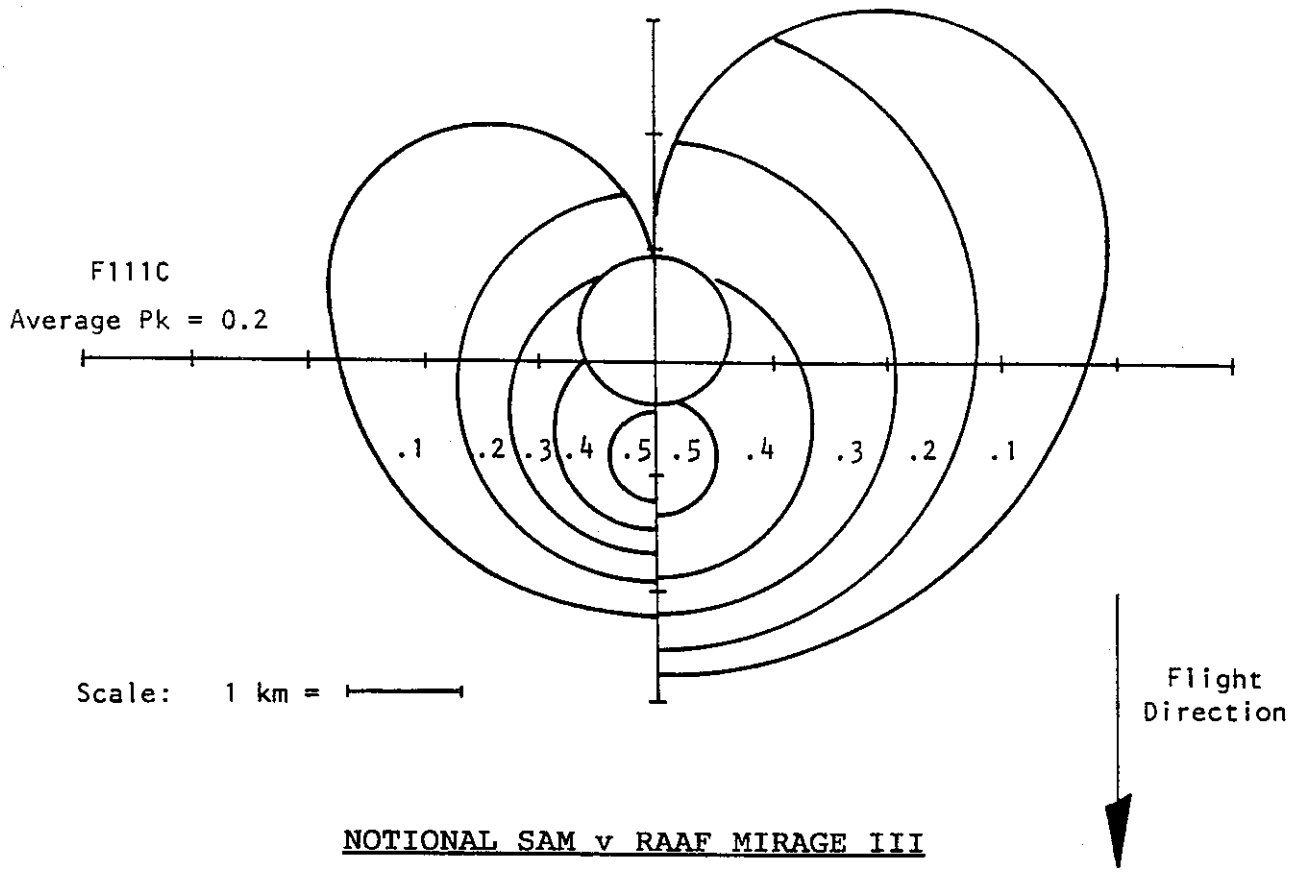
Modifiers

A six sided die is used, but the die roll (combat outcome) can be modified, in favour of the defender or attacker, by the involvement of AEW&C aircraft (eg: E-2s), high performance air defence interceptors (eg: F-14s), EW aircraft (eg: EA-6s), or even 'stealth' aircraft (eg: F-117s).

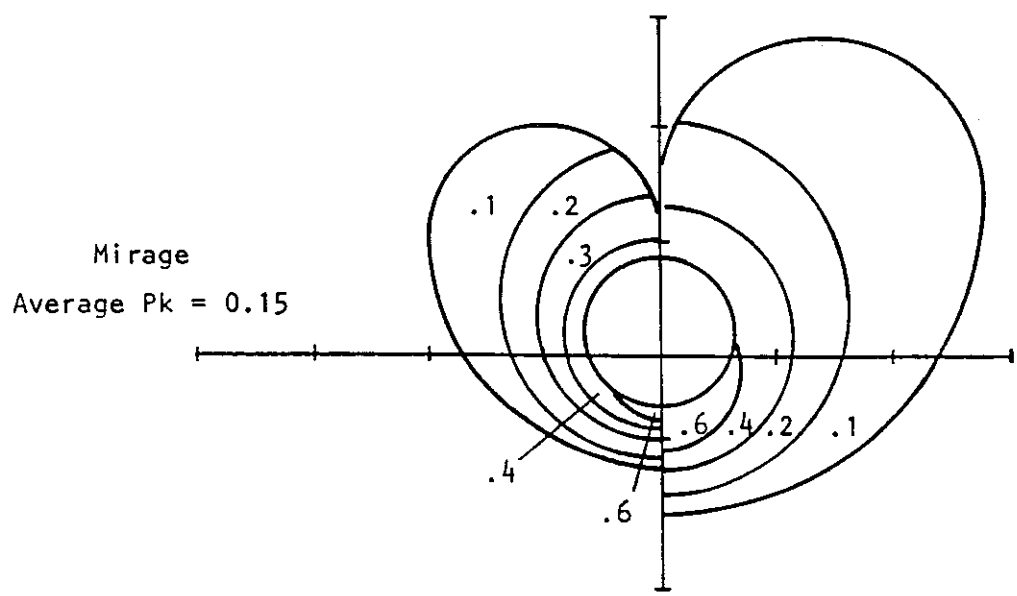
BATMAN

The Battle Management and Strike Effectiveness wargame (BATMAN) was developed in the late 1970s by DSTO. BATMAN uses slightly more complex CRTs than most commercial board wargames.

NOTIONAL SAM v RAAF F-111C

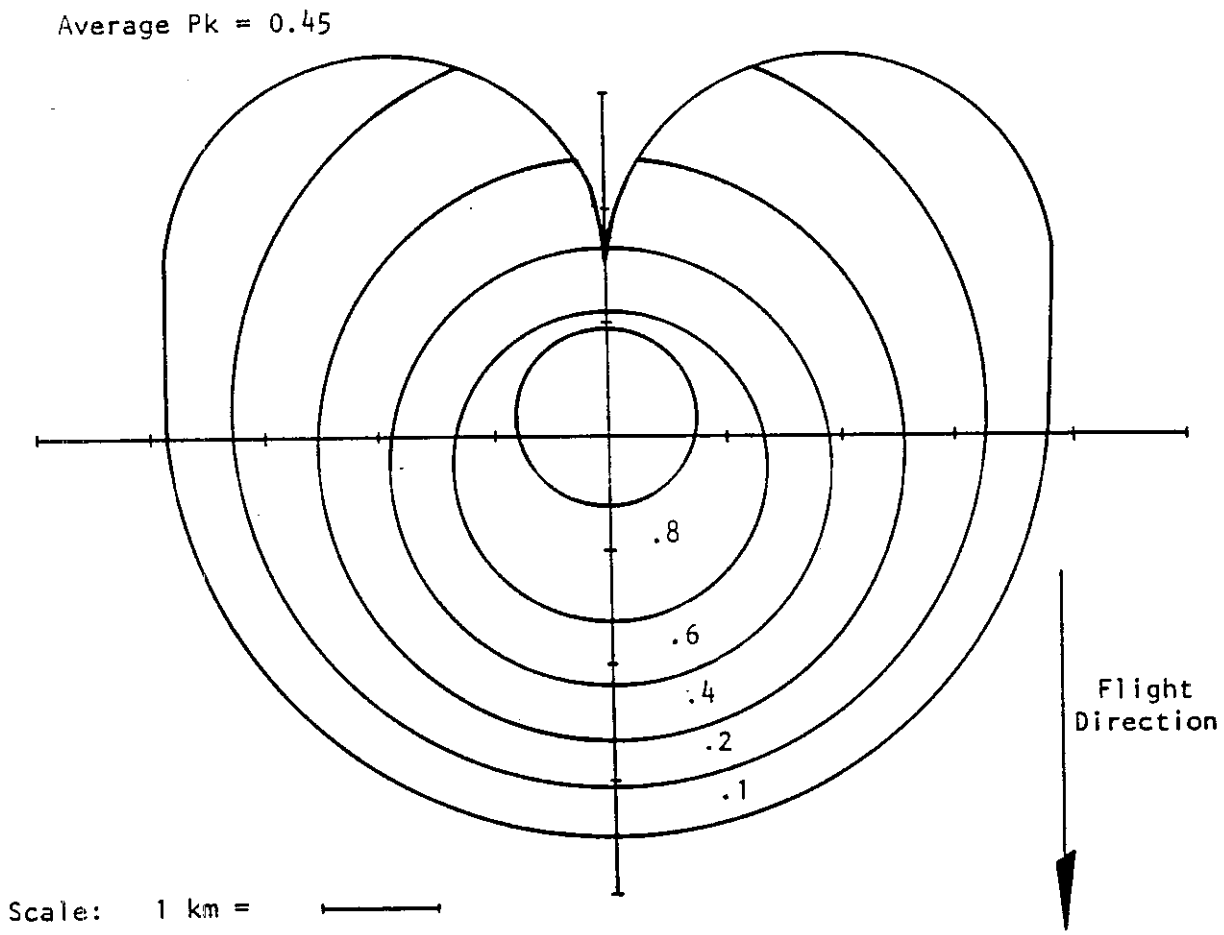


NOTIONAL SAM v RAAF MIRAGE III



Note: Both CRTs assume the aircraft to be on full afterburner.

NOTIONAL SAM v RAAF UH-1H



METHODS OF REPRESENTING TIME IN WARGAMES
ADVANTAGES AND DISADVANTAGES

METHOD	ADVANTAGES	DISADVANTAGES
REAL TIME	realistic decision making under pressure	too time-consuming too many man hours cannot be rerun quickly
FAST TIME	game plays quicker saving time and man hours can be rerun quickly	unrealistic overload in busy periods of game player disorientation (they may lose track & forget to initiate some moves, recalls, etc)
SLOW TIME	players get more time for decision making	too time-consuming too many man hours reruns too slowly
VARIABLE	advantages of fast and slow times	player disorientation umpires' decision to vary rate at any point may disadvantage one side more
EVENT JUMPS	advantages of fast and slow times wastes the least time	player disorientation

NOTE:

An activity (crisis, confrontation, battle) lasting only a few hours of real time can conveniently be simulated in real or slow time, but an activity that takes weeks or months in real time (eg: a campaign or war) can only be conveniently run in fast time, variable time or event jumping.

ANNEX H

INCREASING THE REALISM IN MANUAL WARGAMES

INTRODUCTION

Commercial wargames are designed to be entertaining, so that people will buy them. Commercial wargame designers usually sacrifice realism in the interests of playability, however the surge of popular interest in wargaming since 1970 and the proliferation of personal computers since 1980 have led to a growing market for increasingly complex (realistic) wargames.

Several commercial (manual) board wargames have incorporated relatively simple game conventions that greatly increase the realism of the wargames, at a relatively minor penalty in complexity. These innovations address traditional wargame problem areas, greatly improving the representation of Clausewitzian factors (including 'friction' and 'fog of war') and other classic qualitative factors, including morale, leadership, C^3I effectiveness and the relative pace of actions/reactions.

FRICTION

Just as probability tables can be used to resolve attrition due to combat, so too they can be used to introduce 'friction' factors to the combat simulation. The probability table can be anything from a 'Monte Carlo' random number matrix to a graph based on the Lanchester equations. In wargames run by experienced umpires,selective human intervention can also impact.

Friction factors that can be simulated in wargames include material and systemic failures (such as equipment malfunctions and logistics shortages/errors) and the full range of human failures, under stress (fear induced paralysis, counterproductive action due to confusion or training deficiencies and simple errors of judgement).

Friction can be imposed at predetermined points (which may or may not be known to one or all players), at random, at the umpires' discretion or in a combination of these ways. There can be a range of friction levels, so that the same wargame can be conducted several times, with a different degree of friction each time.

Friction can be applied more to one side than the other. The selective application of friction to one side (by the umpires) can be used to change the balance of probabilities in the other side's favour.

The addition of friction increases the realism of the decision-making problems that players must solve. As in the real world, they never know what will go wrong and must constantly monitor an operation's progress and improvise solutions to unexpected problems. Such wargaming helps train players to anticipate problems and develop plans that include provisions for foreseeable friction.

THE FOG OF WAR

A common criticism of wargames, particularly board games, is that players are given an unrealistic level of knowledge of enemy ORBATs, deployments, tactical/strategic options and constraints and of environmental variables (such as terrain and weather). This 'God's eye' view of the battlefield blows away the 'fog of war'.

The 'fog of war' is relatively easy to simulate. Umpired and computer wargames can be closed, so that each player is given limited (or even false) information about the enemy. Players can also be required to 'buy' intelligence, using scarce reconnaissance assets to collect it all and getting none 'free' from the wargame documentation or umpires.

A simple way to deny players perfect knowledge of each other's force levels and deployments, in a manual wargame, is to lay some or all of the unit markers (playing pieces) face down and have blank (dummy) counters mixed in. A player will not know the exact nature and strength of an enemy unit until it has been engaged, at which point he may find that is is only a decoy or that it is stronger than expected. In an automated game, this is very easily done.

A slightly more sophisticated way is to give each side its own playing surface (map), on which are shown friendly forces and only those enemy units located and identified by reconnaissance or contact. The teams are kept physically separate and thus do not get the 'god's eye view'. This bookkeeping function would have to be co-ordinated by umpires or a computer.

Even more realistic is the method of matching terrain features to units' visibility and field of view. Units' locations are not revealed to the enemy until enemy units are in a position to 'see' them, by proximity or overflight. A unit cannot be 'seen' if it is obscured by hills, trees or camouflage. Such selective revelation usually requires topographical maps, but can be done fairly easily in a manual wargame. The manual wargame 'Panzer Leader' uses colour coded terrain features and a few simple rules to determine line of sight (LOS) and line of fire (LOF).

Detection and identification need not be automatic, on the basis of position alone. A probability table (or umpire judgement) can be used to determine the probability of detection. Weather, time of day and other obscuring factors (eg: smoke) can also be factored into detection probability. A strike aircraft without the appropriate sensors for the visibility conditions (eg: a thunderstorm at midnight) could overfly a concealed target without detecting it. Similar techniques could be applied to determine detection of airborne targets by OTHR, a CRU, an AEW aircraft or a fighter's onboard AI radar. A distinction can also be made between detection and accurate targeting data.

MORALE

Cardboard counters (and electrons in computers) obey without question or doubt and fight fearlessly and tirelessly until victorious or dead. In reality, some military units are less obedient and tenacious than others.

Probability tables or umpire intervention can introduce morale factors into wargames. At any point, randomly or intentionally selected combat elements (down to individual aircrew or aircraft) can fail to press home an attack aggressively, prematurely break off an attack, refuse to attack, retreat against orders or desert. Irresolute non-combatant elements can also fail to meet objectives. Psychological factors such as combat fatigue can also be factored into calculations in this manner.

The level of morale in forces involved in a campaign can change in response to events. Morale may improve after a significant victory or deteriorate after heavy casualties or long periods of effort, inactivity or failure.

All of the above morale factors are subjective. The impact that each is allowed to have on the wargame must be determined on the basis of the judgement of the sponsors, designers and umpires.

LEADERSHIP

Some charismatic and/or brilliant commanders can inspire the troops to fight harder. All leaders are not of uniform effectiveness and most are more skilled at some types of operations than others. Air Marshal Dowding conducted a successful air defence campaign in the Battle of Britain, but may not have been as successful as Air Marshal Harris in commanding the RAF bombing campaign against Germany.

In wargaming, the most straightforward way of simulating differences in leadership style and effectiveness is the team play approach. Each side consists of a team of players who play the roles of commanders and staff officers at various levels. The teams can allocate responsibilities along functional or geographic lines. The overall commander then must deal with decision-making problems. He must assess his subordinates and match their skills and experience to specific missions, prioritise jobs and decide where to assign the better and more mediocre subordinates and supervise subordinates' performance, intervening as required.

A more abstract means of introducing variable leadership qualities to wargaming is to treat the leaders of various echelons as separate playing pieces, assign each a relative value and apply that value as a modifier to the performance of units under command. This modifier could mathematically adjust or bias the results of movement, combat, logistics support or any

variable. In the case of poor leadership, the modifier could even be a negative value.

COMMAND, CONTROL AND COMMUNICATIONS EFFECTIVENESS

As electronic warfare (EW) becomes more widely used, the effectiveness of even the more sophisticated C^3I systems can be degraded. Even if C^3I is unhindered, different formations complete tasks at different rates, depending on factors such as the quality of their staff work, the scale and effectiveness of their EW capability or the vulnerability of their communications net.

A realistic range of C^3I effectiveness can be simulated in a wargame. The simplest means is a probability table than can introduce degrees of degradation to geographic or functional segments of the C^3I system. Such a table can be consulted as the beginning of each turn and the results applied during the turn.

In umpired or computer wargames, orders can be transmitted to units through the control group, which can just lose or garble some or all, randomly, in accordance with a preset plan or at the umpires' discretion. Such factors can also be applied to intelligence dissemination.

In any case, the degree of C^3I degradation suffered by each side can be made known to, or with held from, any or all players, to further complicate their decision-making and planning.

PACE OF OPERATIONS

In modern manoeuvre warfare, the tempo or pace of operations (eg: sortie rate) is the key to success, particularly when fighting outnumbered. Most simple wargames work on the principal that only one side moves at a time, so a player moves all of his units to the limit of their range (subject to terrain and other constraints) and initiates his attacks, before the other side is allowed to react by making any move. This structured turn system is convenient in terms of playability and may be adequate for set piece Napoleonic warfare, but it is unrealistic for modern warfare.

In umpired or computer wargames, the fluid, simultaneous nature of warfare can be simulated by having both sides input their movement and combat plans for each turn, simultaneously. The control group then resolves them on the battlefield simultaneously.

In this manner, a strike aircraft en route to target could be intercepted by an air defence combat air patrol or mobile SAM system that was not there when the strike mission was planned and input.

Many commercial wargames use the simpler method of allowing the phasing player to put some of his fighters up on Combat Air Patrol (CAP). The CAP remains 'up' during the opponents' move and can intercept any enemy aircraft that enter the defended zone.

It is also relatively simple to introduce surges of effort for high tempo operations. Detailed logistics and serviceability tables can allow short term bursts of intensive rates of POL, spares and ordnance use by individual units, at the expense of longer term stock levels, support element readiness and other sustainment factors. A fighter squadron's normal daily sortie rate may be increased by a factor of 0.5 for 24 hours, but then air and ground crew exhaustion, ready ordnance and fuel stocks and/or aircraft serviceability may then be cut by a factor of 0.4 for 36 hours. Computer 'number crunching', makes such complex calculations easier to manage.

Individual aircraft can be allowed to make tradeoffs between payload, flight profile and range. High priority missions can even be 'one way', with escape & evasion or SAR (by aircraft or submarine) plans to give aircrew some hope of survival. There would, of course, be scenarios where both aircraft and aircrew are expendable items.

CONCLUSION

The above methods of introducing variable tempo of operations and realistic action/reation dynamics can increase the uncertainty and complexity of the decision-making problems for players.

Note: Many of the ideas in this annex were inspired by the article: 'Manoeuvre Warfare in Commercial Board Wargames' by Captain Eric Walters, USMC, in Marine Corps Gazette, July 1990, pp 79-83.

ANNEX I

THE LANCHESTER EQUATIONS

The Lanchester Equations were published by Frederick W. Lanchester in 1914 and have been the basis for much of the attrition theory used in wargaming ever since. The Lanchester Equations show the loss rates of two opposing forces under two general conditions of combat.

The first is when one or both of the sides have only general knowledge of the location of the other (eg: both sides in an encounter engagement or the attacker only when the defender is concealed behind prepared or fortified defences). The second is when both sides have accurate information on the location of the other (eg: an engagement on flat open terrain, such as desert)

The two conditions of combat are expressed in two pairs of differential equations. The linear law shows the rate of change of each force with respect to time. The square law shows the rate of change as a constant multiplied by the strength of the opposing force (the side that has the advantage of observation).

Linear Law	dA/dt=kDA dD/dt=k'AD	Opposing sides know only general location of targets.
Square Law	dA/dt=KD dD/dt=K'A	Opposing sides know precise locations of targets.

(where 'A' is the attacker and 'D' is the defender)

There are also two general formulae:

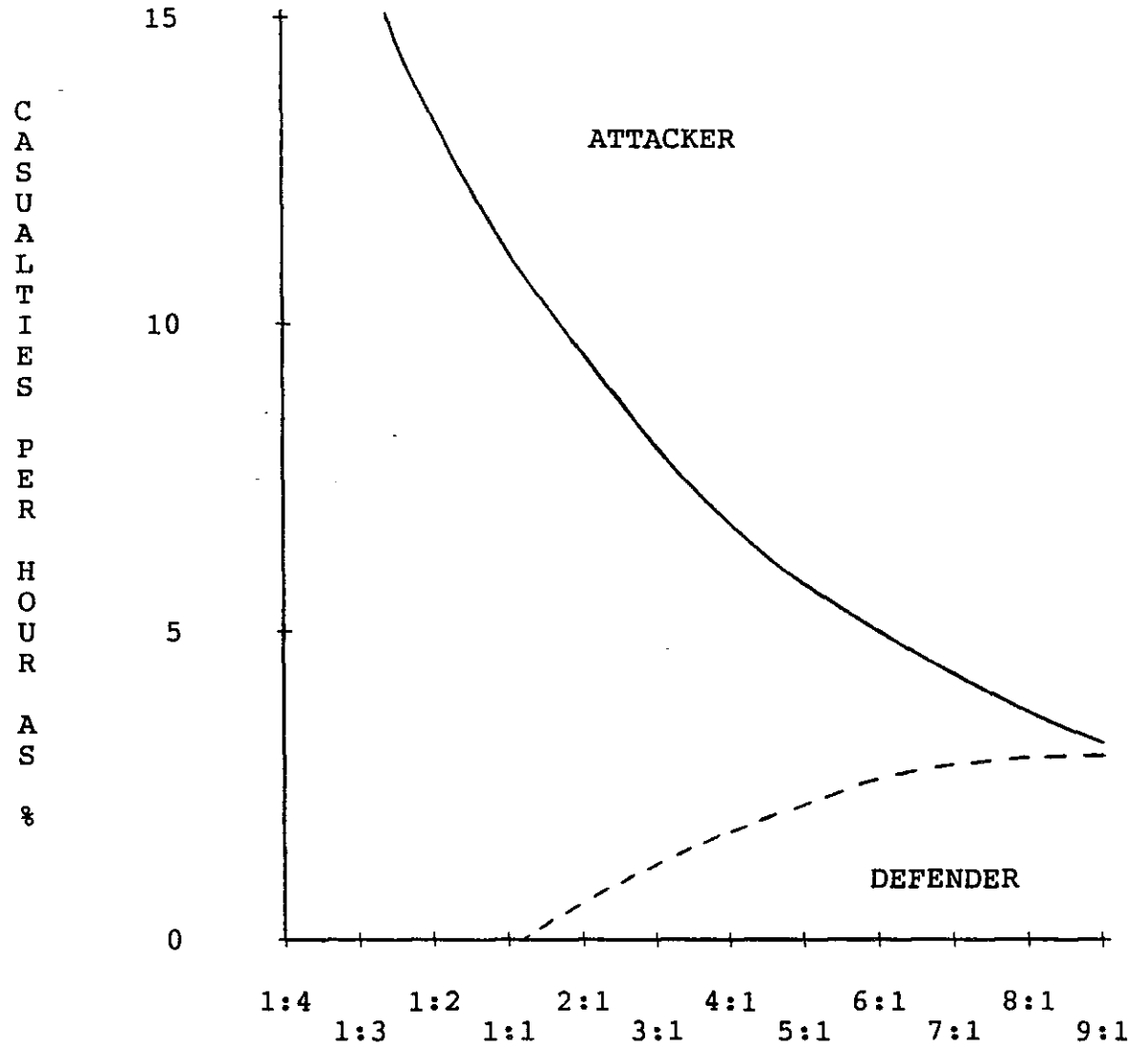
$$dD/dt=CAD^*$$

$$dA/dt=C'DA^*$$

(where * = 1 in linear law and * = 0 in square law)

In most cases of conflict, the Lanchester equations are represented in a modified form, in order to suit the nature of the conflict and the weapon systems employed. The following graph is an example of the employment of modified Lanchester equations suitable for a scenario involving infantry units (at company, battalion or brigade level) supported by armour and artillery. Similar methodology can be used for air warfare and air/surface interaction.

CASUALTY ASSESSMENT GRAPH



Note:
Firepower is expressed as a numerical figure assigned to force elements IAW their size, weapons and tactical posture.

In the above case, the attacker's chances of successs are:

a. at 1:4 or less - virtually nil,

b. at 1:3 to 1:1 - marginal,

c. at 2:1 to 3:1 - some chance, and

d. at 4:1 or more - high probability.

ANNEX J

SOURCES OF WARGAMING ADVICE AND ASSISTANCE

INTRODUCTION

This thesis is intended as a starting point only for wargaming in the RAAF. RAAF units attempting to implement wargaming as part of their training program or to assist in the performance of their missions will encounter many choices and problems of fine detail. There are many organisations within Australia and overseas that can provide expert advice and even assistance (sometimes at no charge) in much greater detail than is possible here.

This annex lists the known sources of wargaming advice and assistance, including:

a. professional wargaming organisations and major wargame users in Australia and overseas,

b. commercial wargame publishers in Australia and overseas (only those that produce modern tactical, operational or strategic games - as opposed to fantasy, science fiction, Napoleonic, etc), and

c. commercial wargaming periodicals (again the modern military ones only), which are the best means of maintaining currency in the art.

Many members of the ADF have been or are involved in hobby wargaming, often in conjunction with hobby computing (there are wargamers on every RAAF base). These people constitute a surprisingly large untapped pool of expertise, with a military background. Any RAAF unit contemplating wargaming should seek out such local wargaming talent, as wargame development and testing are manpower intensive and extra manpower is always useful.

In every Australian capital city there are wargaming clubs, which tend to concentrate on periods (eg: ancient, Napoleonic, World War Two, etc) or genres (eg: role playing, Dungeons & Dragons, post apocalypse, etc). The membership of these clubs includes a wide variety of amateur (hobby) gamers, many of whom are enthusiastic and experienced wargamers. They can be a source of advice on game design and development and can also be useful for game testing (the more a game is test played and the wider the variety of people who test play it; the better). These clubs should not be discounted simply because they are civilian 'amateurs'.

SOURCES OF WARGAMING ADVICE AND ASSISTANCE WITHIN THE ADF

ARMY

Army War Games Centre

Gunshot Alley
Georges Heights SYDNEY NSW

DNATS: 8 29 5296
STD: (02) 960 4411
FAX: (02) 960 4813

Mail: Army War Games Centre
Headquarters Training Command (Army)
c/- Naval Post Office
BALMORAL NSW 2091

Army Scientific Adviser

Russell Offices CANBERRA ACT

Scientific Adviser
G-1-67

DNATS: 8 65 3959

SO1
G-1-66

DNATS: 8 65 4083

Senior Research Scientist
Mr Tom Millane
G-1-64
DNATS: 8 65 4366

AIR FORCE

RAAF College

RAAF Base
POINT COOK VIC 3029

Training Development Flight
DNATS: 8 39 4761

RAAF Staff College

RAAF Base
FAIRBAIRN ACT 2600

Computer System Training Manager
MAJ John Chapuis
DNATS: 8 60 6664

Air Force Scientific Adviser

Russel Offices CANBERRA ACT 2600
A-9-08

DNATS: 8 65 5550

HQADF

ADF Warfare Centre

RAAF Base
WILLIAMTOWN NSW 2314

Deputy Director of Wargaming
LTCOL Duncan Burns

DNATS: 8 41 7076

Australian Defence Force Academy

Russell Offices CANBERRA ACT 2600

Department of Computer Science
Senior Lecturer Dr Charles Newton

STD: (06) 268 8956
FAX: (06) 268 8581

Defence Science & Technology Organisation

Air Research Laboratory
Mr David Spivakovsky

STD: (03) 647 7719

SOURCES OF WARGAMING ADVICE AND ASSISTANCE
FOREIGN MILITARY

US NAVY

Centre for Naval Analyses

Director
System Evaluation and Acquisition Program
Centre for Naval Analyses
4401 Ford Avenue
Alexandria VIRGINIA 22303-0268

Phone: (703) 824 2000

Naval War College

Director
Wargaming Department
Naval War College
Newport RHODE ISLAND 02841-5010

US MARINES

Marine Corps Combat Development Command

Director
Wargaming and Analysis Centre
Marine Corps Combat Development Command

US AIR FORCE

Air Force Wargaming Centre

Director
Air Force Wargaming Centre
Center for Aerospace Development, Research and Education
Air University
Maxwell AFB
Montgomery ALABAMA 36112-5532

Phone: (203) 293 3528 (Analysis Division)
FAX: (203) 293 2593

US DEPARTMENT OF DEFENSE

National Defence University

Director
Wargaming and Simulation Department
Institute for National Strategic Studies
National Defence University
Fort McNair
Washington DC 20319

Phone: (202) 475 1251

ROYAL AIR FORCE

Director of Defence Studies
RAF Staff College
BRACKNELL BERKS RG12 3DD

Phone: Bracknell 54593 (Ext 298)

Wargaming System Manager
Department of Air Warfare
RAF College

SOURCES OF WARGAMING ADVICE AND ASSISTANCE CIVILIAN WITHIN AUSTRALIA

SYDNEY

Strategic Studies Group (SSG) Pty Ltd

PO Box 261
DRUMMOYNE NSW 2047

President - Mr Ian Trout

STD: (02) 819 7199

SSG has produced many automated wargames, originally for Commodore and Amiga type computers. They now produce their wargames for IBM PCs, as there is now a large enough market in Australia. The company designs and develops its own games and markets them in Australia and the US.

Their products include: 'Europe Ablaze' (USAAF & RAF strategic bombing campaigns in Europe - 1940 to 1944), and 'Carriers at War' (Aircraft Carrier operations in the Pacific - 1941 to 1945).

Their IBM Battle Front software is designed to be user-convertible to any modern land warfare scenario.

MIMICS Pty Ltd

21 Wood Street
EASTWOOD NSW 2122

Sales Manager - Mr Michael Brincat-Lisano

STD: (02) 868 3572 FAX: (02) 868 2638

MIMICS is a Scientific Management Consultancy firm. They have the Australian marketing rights to the USAF TAC THUNDER wargame. MIMICS is not in the business of wargame design or development.

CANBERRA

Panther Games Pty Ltd

McNicoll Street
Hughes
CANBERRA ACT 2605

President - Mr Dave O'Connor

STD: (06) 281 5150

Panther games design and develop their own IBM (PC) computer wargames and market them in Australia.

MELBOURNE

Military Simulations

134 Cochranes Road
MOORABBIN VIC

STD: (03) 555 1022

Military Simulations was founded in the early 1970s and was a very innovative design and production house for about a decade.

Their games were very simple (usually only four or five pages of rules) 'beer & pretzel' games, but they were still clever enough to exercise the players' decision making skills. The games were all based on World War Two theatres of operations (land and sea with abstract air power).

The company no longer designs wargames. It merely markets its old products and exercises the distribution rights for Avalon Hill in Australia.

JEDKO Games

Military Simulations used to be called JEDKO Games and its old products still bear the JEDKO label.

Conflict Simulations of Australia Pty Ltd

4 Parklands Avenue
CHIRNSIDE PARK VIC 3116

Mainly computer games (Amiga, Commodore, IBM PC).

BRISBANE

The Australian Wizard

PO Box 1171
STAFFORD QLD 4053

Publishers of El Mythico, a company level tactical simulation of COIN warfare in the Central American jungles that factors in the international political dimension. A combination of low level tactical and high level Mil/Pol.

SOURCES OF WARGAMING ADVICE AND ASSISTANCE CIVILIAN OVERSEAS

PROFESSIONAL MILITARY

RAND Strategy Assessment Centre

RAND Corporation
1700 Main Street
PO Box 2138
Santa Monica CALIFORNIA 90406-2138
USA

COMMERCIAL HOBBY WARGAME PUBLISHERS

Attack Wargaming Association

314 Edgley Avenue
Glenside PENNSYLVANIA 19038
USA

Avalon Hill

The original and largest commercial wargame company.

4517 Harford Road
Baltimore MARYLAND 21214
USA

Battleline Publications

Avalon Hill subsidiary

Brassey's Simulation Division

Brassey's and Mirrorsoft (London) in partnership with Sphere Inc (Alameda, California). Computer wargames - 1980s scenarios.

Brassey's Simulation Division
Brassey's
24 Gray's Inn Road
London WC1X 8HR
BRITAIN

The Chaosium

Mainly fantasy games.

PO Box 6302
Albany CALIFORNIA 94706
USA

Command Perspectives

19th century land warfare (eg: US Civil War).

3522 Polk Avenue
San Diego CALIFORNIA 92104
USA

Creative Wargamers Workshop

Some Mil/Pol games.

Suite 1E
330 East 6th Street
New York NEW YORK 10003
USA

Decision Games (aka Cummins Enterprises)

Revivals of some of the 'Golden Oldies'.

PO Box 1289
Salinas CALIFORNIA 93902
USA

Excalibre Games

1177 Ottawa Street
Windsor ONTARIO N8X 2E4
CANADA

Fantasy Games Unlimited

PO Box 182
Roslyn NEW YORK 11576
USA

Flying Buffalo Inc

PO Box 1467
Scottsdale ARIZONA 82852
USA

Game Designers' Workshop

Very innovative designers in the early 1980s.
Original publishers of three excellent families of wargames - 'Fleet', 'Assault' and 'Europa'.

203 North Street
Normal ILLINOIS 61761
USA

Games Design & Research (GR/D)

New publishers of 'Europa' series.

PO Box 591
Grinnell IOWA 50112-0591
USA

GMT Games

Publishers of 'Guadalcanal', which integrates land, sea and air warfare, without abstracting any.

310 West Lacey Street
Hanford CALIFORNIA 93230
USA

Historical Alternatives

1142 South 96th Avenue
Zeeland MICHIGAN 49464
USA

Historical Perspectives

PO Box 343
Flushing Station
Flushing NEW YORK 11367
USA

Imperium Publishing Company

PO Box 8954
Minneapolis MINNESOTA 55440
USA

Martial Enterprises

Mainly Napoleonic wargames.

825 Washington Street
El Cajon CALIFORNIA 92020
USA

Metagming Concepts

PO Box 15346
Austin TEXAS 78761
USA

Omega Games

6728 Memorial Highway
Suite 149
Tampa FLORIDA 33615
USA

Operational Studies Group

1261 Broadway
New York NEW YORK 10001
USA

Orisek Industries

Marketers of many useful gaming accessories.

PO Box 52
Hinsdale ILLINOIS 60521
USA

Peoples' War Games

3972 Gardenia Place
Oakland CALIFORNIA 94605
USA

Philmar Ltd

47-53 Dace Road
London E3 2NG
BRITAIN

Phoenix Games

12180 Neld Street
Rockville MARYLAND 20852
USA

S & G Games

2105 Custer Avenue
Bakersfield CALIFORNIA 93304
USA

Simulation Games

Eton Lodge
Highwood
Chelmsford Essex CM1 30H
BRITAIN

Simulations Canada

PO Box 452
Bridgewater NOVA SCOTIA B4V 2X6
CANADA

WW2 computer games.

Simulations Publications Incorporated (SPI)

The leading wargame innovators of the 1970s.

275 Park Avenue South
New York NEW YORK 10010

Sopac Games

Mainly naval wargames.

1226 Jupiter Avenue
Reedsport OREGON 97467
USA

Swedish Game Productions

Formerly Wellington Wargames.

S-59040 Kisa
SWEDEN

TSR hobbies

Publish a good tactical level Battle of Britain game.

PO Box 756
Lake Geneva WISCONSIN 53147
USA

West End Games

Publishers of some air power wargames.

PO Box 156
Cedarhurst NEW YORK 11516
USA

3W

3W Inc
PO Box F
Cambria CALIFORNIA 93428
USA

XTR

Mainly playable WW2 divisional level land wargames.

PO Box 4017
San Luis CALIFORNIA 93403
USA

Yaquinto Publications Inc

Innovative, if offbeat.

PO Box 24767
Dallas TEXAS 75224
USA

COMMERCIAL WARGAMING PERIODICALS
GENERAL WARGAMING

Ares

Published by SPI.

Campaign

PO Box 896
Fallbrook CALIFORNIA 92028
USA

Cheader's Digest

Games By Mail
Department B
Bradbrook Road
Toronto ONTARIO M8Z 5V3
CANADA

Command

Published by XTR.

Fire & Movement

Published by Decision Games.

Games & Puzzles

34 Hanway Street
London W1A 4 XF
BRITAIN

The General

Published by Avalon Hill.

The Grenadier

Published by Game Designer's Workshop.

Moves

Published by Decision Games.

Panzerfaust

The original title of 'Campaign'. Old copies still in circulation.

Perfidious Albion

5 Albion Terrace
Guisborough
Cleveland TS14 6HJ
BRITAIN

Phoenix

Published by SPI.

Run 5

Published By Strategic Studies Group.
Only good Australian wargaming periodical.
Computer wargames - mainly WW2.

Strategy & Tactics

Published by Decision Games.

The Wargamer

Published by Simulation Games (Britain).

Wargames Illustrated

Stratgem Publications
18 Lovers Lane
Newark Notts NG24 1HZ
BRITAIN

Mainly miniatures wargaming.

COMMERCIAL WARGAMING PERIODICALS
COMPUTER WARGAMES

Breakout

The Australian Gamers' Quarterly.

Published by Conflict Simulations (of Australia) and GR/D (of the US).

Computer Gaming World

Megazone

Australia's Electronic Entertainment magazine.

Strategy: Plus

Lamberton House
27 High Street
London W5 5DF
BRITAIN

ANNEX K

AIR POWER WARGAMES AVAILABLE TO AUSTRALIA IN 1991

INTRODUCTION

What follows are brief descriptions of a representative cross section of the hundreds of wargames available to Australia. Most of the professional wargames are automated games used by the US Defense Department. The wargames described have been used in analysis and training and simulate the following areas:

a. logistics,

b. air-to-air missile pK,

c. the effectivenss of given (Soviet) SAMs,

d. the force multiplier effect of AWACS,

e. air-to-air refuelling support requirements for given fighter-bomber tasks,

f. air attacks on air bases,

g. close air support and other tactical air roles, and

h. the penetration of defended enemy airspace by packages of fighters, bombers, support aircraft and criuse missiles.

They include wargames currently in use in Australia (or developed here but no longer in use), and wargames available from the US Department of Defense.

More detailed information on the wargames developed and/or in use in Australia is available from the sponsors, developers and users listed. More detailed information on the US wargames is available in the Catalog of Wargaming and Military Simulation Models, published by the US Joint Chiefs of Staff, a copy of which is held at the RAAF Air Power Studies Center.

MICROCOMPUTER FORCE ANALYSIS SIMULATION THEATRE ADMINISTRATION & LOGISTICS SUPPORT (MICRO FASTALS) (1987)

Purpose

The development of balanced, time-phased support force requirements for a given combat force. Primarily for quick response, low intensity force planning studies and analyses.

Domain

Land.

Geographic Span

Theatre.

Environment

Theatre dependent - any appropriate environment.

Force Composition

Army support units.

Scope of Conflict

N/A

Time Processing

Normal time.

Treatment of Randomness

Deterministic.

Sides

One-sided.

Human Participation

Not permitted during execution.

Major Hardware:	IBM compatibles with 640k RAM
Programming Language:	LOTUS 1-2-3 (MS-DOS)
Major Users:	US Army Concepts Analysis Agency

MODEL OF ARMY WORLWIDE LOGISTICS (MAWLOGS) (1974)

Purpose

An operations support tool that simulates a wide range of alternative logistics system structures, policies and procedures (including supply, transport and communications) and measures workloads, performance and costs.

Domain

Land and Air.

Geographic Span

Variable - from local to global.

Environment

Variable - almost any.

Force Composition

Variable levels of the logistics system.

Scope of Conflict

Conventional, Chemical and Nuclear.

Time Processing

Dynamic event stepping.

Treatment of Randomness

As required by the user (stochastic or deterministic).

Sides

One-sided.

Human Participation

N/A

Major Hardware:	VAX 11/780, UNISYS 1100 series
Programming Language:	FORTRAN IV, FORTRAN 77 and GASP IV
Major Users:	US Army and BDM Corporation

BETA
(1981)

Purpose

Computes the probability that a missile with a blast fragmentation warhead will 'kill' a given aircraft target. Includes probability of successful fusing.

Domain

Land, sea or Air.

Geographic Span

Individual missiles and aircraft.

Environment

N/A

Force Composition

One missile and one aircraft.

Time Processing

Dynamic.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided non-reactive.

Human Participation

Not permitted.

Major Hardware:	VAX 11/780
Programming Language:	FORTRAN IV
Major Users:	USAF Weapons Research Development Centre (Avionics Laborarory)

PENETRATION ASSESSMENT OF TERMINAL ENGAGEMENTS (PASTE) (1968)

Purpose

Evaluates the effectiveness of penetrator characteristics, including radar cross section, speed, manoeuverability and flight attitude. Simulates one-on-one engagements of SAM sites with ASMs. Also evaluates penetrator survivability.

Domain

Land, Sea and Air.

Geographic Span

Individual or local.

Environment

Terrain relief, cultural features and sea states.

Force Composition

One penetrator and up to 70 SAM sites.

Scope of Conflict

Conventional, with some nuclear effects.

Time Processing

Dynamic event stepping.

Sides

One-sided.

Human Participation

Not permitted during execution.

Major Hardware:	DEC-VAX 11/780 or IBM 332/360/370
Programming Language:	FORTRAN 77
Major Users:	US Army Missile Command, Boeing, USAF

MULTIPLE AWACS SIMULATION: PENETRATOR / INTERCEPTOR COMBAT MODEL (MULTI-ASPIC) (1987)

Purpose

Evaluates engagements between penetrators and interceptors directed by AWACS. Determines possible times, angles and co-ordinates at which an AWACS-directed interceptor can detect and 'kill' a penetrator.

Domain

Air (factors in land for aircraft basing only).

Geographic Span

Multiple AWACS surveillance areas.

Environment

Limited terrain features as they effect detection.

Force Composition

BLUE and RED forces, with fighters, bombers, AWACS and up to 10 AWACS surveillance and orbtial areas.

Scope of Conflict

Conventional (including AAMs, guns and ALCMs).

Time Processing

Dynamic event stepping.

Treatment of Randomness

Monte Carlo, based on player attrition / pK.

Sides

Two-sided.

Human Participation

Required for input of data base and mission planning.

Major Hardware:	VAX 11/780 with VMS
Programming Language:	FORTRAN IV and FORTRAN 77
Major Users:	USAF Operations Analysis

AIR SUPERIORITY / AIR DEFENCE TANKERS ANALYSIS MODEL (ADTAM)
(under development)

Purpose

To determine the tanker requirements for the refuelling support of a continuous barrier combat air patrol operation, with intermittent forward excursions to engage and defeat intruders beyond the barrier.

Domain

Land and Air.

Geographic Span

Global.

Environment

Distances.

Force Composition

Fighter force and Tanker support element.

Scope of conflict

Conventional.

Time processing

Dynamic time stepping.

Treatment of Randomness

Deterministic.

Sides

One-sided.

Human Participation

Required to set up data files for execution.

Major Hardware:	Network of APOLLO DN3000 and DN660
Programming Language:	APOLLO DOMAIN Pascal FORTRAN APOLLO DOMAIN/IX
Major Users:	USAF Tanker/Airlift Support Group USAF OPerations Analysis Boeing

AIR BASE ATTACK MODEL (ABATAK)
(1983)

Purpose

A research and evaluation tool, used to determine weapon system effectiveness, force capability and force requirements for air base attack (including attack effectiveness and sortie generation resource planning).

Domain

Single airbase.

Geographic Span

Multi-day sortie generation for a single base.

Environment

Time of day and geographic distribution of airbase facilities and interconnecting runways/taxiways/roads.

Force Composition

Single airbase with all forces and infrastructure.

Scope of Conflict

Conventional and nuclear/chemical weapons effects.

Time Processing

Dynamic event stepping.

Treatment of Randomness

Deterministic with random values generated by inputs.

Sides

One-sided.

Human Participation

Not required, but model can be interrupted (rescheduled).

Major Hardware:	VAX/VMS family
Programming Language:	FORTRAN (with DISSPLA graphics)
Major Users:	USAF

AIR COURSE OF ACTION ASSESSMENT MODEL (ACAAM) (1988)

Purpose

Used to assess strike plans for the delivery of conventional weapons by aircraft and cruise missiles.

Domain

Air / sea.

Geographic Span

Ranging from local to global.

Environment

Includes terrain and cultural features.

Force Composition

Force elements.

Scope of Conflict

Conventional.

Time Processing

Dynamic event stepping.

Treatment of Randomness

Monte Carlo.

Sides

Reactive two sided.

Human Participation

Required for decisions and processes.

Major Hardware:	MicroVAX (VMS 4.5) GENISCO graphics terminal
Programming Language:	Ada, FORTRAN
Major Users:	US Joint Chiefs US CINCPAC

ADVANCED CAMPAIGN EFFECTIVENESS MODEL (ACE)
(1987)

Purpose

Simulates an offensive of bombers, cruise missiles and support aircraft penetrating a defensive structure of ground and air threats (with extensive use of pK tables).

Domain

Air.

Geographic Span

Theatre or global.

Environment

Geographically based (latitude / longitude).

Force Composition

Combined and joint forces.

Scope of Conflict

Conventional and strategic nuclear.

Time Processing

Dynamic event stepping.

Treatment of Randomness

Monte Carlo or deterministic.

Sides

Reactive two sided asymmetric.

Human Participation

Not permitted.

Major Hardware:	IBM 4341 (VM CMS) or 3084 (MVS/TSO) or VAX 11/780 (VMS)
Programming Language:	ANSI FORTRAN 77
Major Users:	Rockwell corporation US NAA

JANUS(T)
(1983)

Purpose

Interactive, near-real-time, combat development tool for exploring the relationships of combat and tactical processes. Forces players to make doctrinal and tactical decisions, deploy forces, develop scenarios and formulate and execute plans.

Domain

Air / land / sea.

Geographic Span

Battalion / brigade level.

Environment

3 Dimensional terrain (vegetation, rivers, roads, towns, day / night, wind direction, temperature and humidity).

Force Composition

Combined and joint forces.

Scope of Conflict

Conventional and limited chemical.

Time Processing

Dynamic event sequenced.

Treatment of Randomness

Stochastic.

Sides

Reactive two sided asymmetric.

Human Participation

Required for decisions and processes.

Major Hardware:	IBM PC (640 Kbyte memory)
Programming Language:	FORTRAN and 'C'
Major Users:	US Armed Forces Staff College US National Defense University Australian Army War Games Centre

PROMETHEUS
(1990)

Purpose

To drive a student exercise that trains RAAF Command & Staff College students in how air power is employed, both offensively and defensively. PROMETHEUS was originally developed by RAAF Staff College as a manual wargame.

Domain

Air and Land.

Geographic Span

Regional - NW Australia and 'Kamaria'.

Environment

Smooth earth, no terrain, limited 'weather' effects.

Force Composition

RED strike force of Fitters and Fencers (with EW).
BLUE defence force of F/A-18s and Rapier SAMs (with AEW).

Scope of Conflict

Conventional.

Time Processing

Dynamic - either real time or event stepping.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided.

Human Participation

Required to input strike packages and interceptor, AEW and SAM deployments and schedules. BLUE can react (scramble or CAP) to incoming strikes as they happen.

Major Hardware:	NCR Tower network
Programming Language:	.....
Major Users:	RAAF Command & Staff College

BALBOA
(1989)

Purpose

To drive a student exercise that trains USAF Captains on how the USAF employs airpower.

Domain

Primarily aerospace, with supporting ground functions.

Geographic Span

Regional (Panama, Colombia & Venezuela).

Environment

Same details as US 1:250,000 joint ops graphic charts.

Force Composition

USAF tactical elements and US Army air defence artillery.

Scope of Conflict

Regional, low intensity conflict. Planning includes rear area support.

Time Processing

Dynamic event stepping or real time.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided (RED is non-reactive).

Human Participation

BLUE side requires participation for decisions and processes. RED side is managed by control group.

Major Hardware:	BALBOA is a manual wargame.
Programming Language:	BALBOA is a manual wargame.
Major Users:	USAF Squadron Officer School.

MODULAR AIR WAR MODEL (MAWM)
(1986)

Purpose

To investigate the impact of tactical airpower on theater air and ground combat, over a 10 day period. Includes second echelon and interdiction attacks.

Domain

Air and land.

Geographic Span

Any theater can be modelled. Only the Central Europe data base is currently complete.

Environment

Day/Night, defensive positions, three terrain levels and logistics supply network.

Force Composition

Combined forces

Scope of Conflict

Primarily conventional (some chemical and biological effects possible).

Time Processing

Dynamic event stepping.

Treatment of Randomness

Deterministic.

Sides

Two-sided assymetric.

Human Participation

Not required.

Major Hardware:	DEC VAX (VMS operating system)
Programming Language:	FORTRAN Extended
Major Users:	McDonnell Douglas Advanced Tactical Fighter Project

TAC BRAWLER
(1976)

Purpose

A research and evaluation tool and an operations support tool. Represents the effects of hardware and tactics on air-to-air combat.

Domain

Air.

Geographic Span

Local.

Environment

Smooth earth, no terrain up to 10 cloud layers. Models each aircraft, avionics system and missile explicity.

Force Composition

Flight v Flight.

Scope of Conflict

Conventional air-to-air.

Time Processing

Dynamic event stepping.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided assymetreic. Both sides are reactive.

Human Participation

Not required.

Major Hardware:	IBM or VAX mainframe (UNIX based)
Programming Language:	FORTRAN
Major Users:	USAF HQ TAC US Naval Weapons Center Most US aerospace companies

BATTLE MANAGEMENT & STRIKE EFFECTIVENESS (BATMAN) (1978)

Purpose

To assist in the training of Australian Army and RAAF officers in joint warfare battle management and to demonstrate the effectiveness of air-to-surface and surface-to-air weapons. (BATMAN is a computer assisted game - paper maps are used)

Domain

Air and Land.

Geographic Scope

A 600 sq klm coastal area in the Northern Territory.

Environment

Day only, no weather, terrain as per standard Army 1:250,000 survey maps.

Force Composition

RED mechanised battalion, with SP Arty, SPAAGs and SAMs. BLUE composite wing, with F-111C (6), Mirage III (12) and UH-1H (12) and small airmobile infantry force.

Scope of Conflict

Conventional.

Time Processing

Dynamic event stepping or real time.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided (both fully reactive).

Human Participation

Required for decisions and processes.

Major Hardware:	HP 9825 Desk Top
Programming Language:	unknown
Major Users:	currently not in use

TAC THUNDER
(1984)

Purpose

To assess operations plans, develop targeting strategies, evaluate weapon systems and study doctrine, strategy, tactics, force structure and logistics.

Domain

Air and Land.

Geographic Span

Theatre.

Environment

Day/night, weather and terrain.

Force Composition

Joint and Combined forces.

Scope of Conflict

Conventional.

Time Processing

Dynamic real time or event stepping.

Treatment of Randomness

Monte Carlo.

Sides

Reactive two-sided.

Human Participation

None required for decisions. User can interrupt.

Major Hardware:	IBM, VAX or SUN computers
Programming Language:	SIMSCRIPT II.5
Major Users:	Several USAF Major Commands

AIR TOTAL ENGAGEMENT MODEL

Purpose

Analysis of air-to-air missile combat between F-16, F/A-18, Tornado and Su-27 aircraft, using AIM-7E/F, Skyflash and AA-10 missiles and APG-65/66 sensors.

Domain

Air.

Geographic Span

Local.

Environment

Clear air (no weather).

Force Composition

One-on-one and few-on-few.

Scope of Conflict

Conventional.

Time Processing

Dynamic, real time.

Treatment of Randomness

N/A

Sides

Two-sided.

Human Participation

N/A

Major Hardware:	VAX or Prime (will convert to IRIS)
Programming Language:	FORTRAN
Major Users:	RAE Farnborough

PACAUS
(1991)

Purpose

Analysis of air-to-air combat, using AIM-7F, AIM-9L and MATRA-R550 missiles and radar, IR, RWR and radio GCI sensors.

Domain

Air.

Geographic Span

Local.

Environment

Clear air (no weather).
EW capability under development.

Force Composition

One-on-one to four-on-four (also one-on-seven).

Scope of Conflict

Conventional.

Time Processing

Dynamic, real time.

Treatment of Randomness

N/A

Sides

Two-sided.

Human Participation

N/A

Major Hardware:	VAX 11/780 or IRIS 4D/70GT
Programming Language:	FORTRAN
Major Users:	RAAF DSTO (ARL)

SINGLE AIRCRAFT STRIKE SIMULATOR

Purpose

Analysis and training. RAAF strike pilot flies simulator to attack a surface target while a RAAF/RAN air defence officer operates an Air Defence Command Post to defend the target.

Domain

Air and Land.

Geographic Span

Local.

Environment

Air-to-surface in an Air Defence Ground Environment.

Force Composition

Single strike aircraft.

Scope of Conflict

Conventional.

Time processing

Dynamic, real time.

Treatment of Randomness

N/A

Sides

Two-sided.

Human Participation

Man-in-the-loop.

Major Hardware:	IRIS workstations in network
Programming Language:	FORTRAN, PASCAL and MODULA-2
Major Users:	RAAF RAN DSTO (ARL)

STRATEGIC ELECTRONIC WARFARE SCENARIO SIMULATOR (STEWS)

Purpose

Scenario generator and ESM receiver model.

Domain

Abstract.

Geographic Span

Local.

Environment

Electronic Warfare.

Force Composition

No combat forces - emitters and sensors only.
(Electronic Combat?)

Scope of Conflict

Conventional.

Time Processing

Dynamic, real time.

Treatment of Randomness

Deterministic.

Sides

One-sided.

Human Participation

None after initial parameters are set.

Major Hardware:	VAX/VMS
Programming Language:	FORTRAN
Major Users:	DSTO Salisbury US National Research Laboratory

SCENARIO GENERATOR AND RECEIVER SIMULATION

Purpose

Analysis of unclassified generic ESM receiver models and various emitter characteristics, including on-times, frequencies, pulse width, PRF, scan type, antenna pattern, staggers and jitter).

Domain

Abstract.

Geographic Span

Local.

Environment

Electronic Warfare.

Force Composition

No combat forces - emitters and sensors only. (Electronic Combat?)

Scope of Conflict

Conventional.

Time Processing

Dynamic, real time.

Treatment of Randomness

Monte Carlo.

Sides

Two-sided (emitters v sensors).

Human Participation

N/A

Major Hardware: IBM 370

Programming Language: SIMSCRIPT II.5

Major Users: DSTO

ANNEX L

WARGAMING BIBLIOGRAPHY

There is a huge mass of literature on wargaming. Much of it is either oriented towards the commercial hobbyist or focussed on very specific 'professional' military issues.

This bibliography contains a few selected books, reports, papers and journal articles that are either useful introductions to the art of wargaming or focus on (and explain in detail) some specific aspect of wargaming that is relevant to the RAAF. The bibliography is by no means exhaustive and many of the references include bibliographies of their own, which can lead to much useful further reading.

Given the Americans' leading role in post-war wargaming, most of the references are for US authors, particularly from the US Navy's Centre for Naval Analysis and the RAND Corporation. The bibliography is divided into the following sections:

a. wargaming generally (including history and design),

b. automated wargaming,

c. strategic and military/political gaming,

d. command & control and battle management gaming,

e. 'thinking red' in wargaming,

f. increasing the realism and military content of wargames,

g. air power wargaming,

h. probability theory and operations analysis (including the Lanchester equations), and

i. wargaming catalogs.

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Australian Army War Game Centre (AWGC) Handbook, Army War Game Centre, Georges Heights, Sydney, annual editions.

Details of the five wargames currently conducted by the AWGC, several of which include air power components.

Catalog of Wargaming and Military Simulation Models, Directorate of Force Structure, Resource and Assessment, The Joint Staff, Washington DC, annual editions.

Details of 350 games conducted by the US armed forces, including many USAF and US Navy air power wargames.

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GLOSSARY OF WARGAME TERMS

Advance after Combat

In many land warfare games, the attacker is allowed to occupy a hex from which the defender has been forced to retreat. Sometimes, further exploitation is allowed.

Analysis

Abbreviated form of 'operations research and analysis', which is the quantified, objective, scientific investigation of a specific physical phenomenon. Analysis often produces the models or algorithms that constitute the underlying mechanics of a game.

Blue

The traditional identifying colour of friendly forces in a wargame.

Breakdown

Often, unit counters can be 'broken down' into smaller sub units. A fighter squadron counter may be broken down into flights, sections or even individual aircraft - as required.

Combat Results

The outcome of an engagement (combat result) can be any of the following. The attacking force can be completely eliminated, attrited (suffer some level of casualties - with loss of mobility and/or firepower), compelled to retreat, disrupted (with loss of mobility and/or firepower) or just blocked from moving forward. The same range of results can effect the defender. In air warfare games, mission abort and physical damage to the aircraft can also result.

Combat Strength

A numerical rating of a unit's ability to attack and defend. The strength is calculated on the basis of raw firepower, modified by qualitative factors such as morale, experience, training, leadership and organisational effectiveness. Mobility, EW and other force multipliers may also impact on the rating.

Counter

A playing piece in a wargame is often called a counter. A counter can represent a combat unit, a structure (eg: a fort, a base), a status (eg: out of ammunition, out of fuel, isolated, damaged) or any other game feature that needs to be represented on the playing surface.

Dummy Unit

A dummy unit is a unit that appears (to the enemy) to be real, but is only a decoy. The enemy thus wastes resources on the dummy.

Entry/Exit Costs

There is a movement cost to either enter or exit every hex. The cost can be due to terrain (entering a clear hex in fine weather is 'cheaper' than entering a mountain hex in wet weather and even aircraft movement can be effected by weather) or zones of control (q.v.).

Facing

In tactical land warfare games, the direction that a unit is facing (which of the six hex sides is the front, flank, etc) is vital and must be clearly stated.

Game

A physical or mental competition conducted according to rules, with the participants in direct opposition to each other, attempting to influence events by their decisions.

Automated Game

A simulation of a competitive situation conducted completely on computer; the only human intervention being orders input to the computer by players and umpires.

Closed Game

A game in which each player has only such knowledge of his own and his opponent's situation as is transmitted to him by the game control group (q.v.).

Computer Game

See automated game.

Computer-assisted Game

A manual game that uses computer assistance for bookkeeping and resolving the outcomes of interactions. Also called a manual-computer game.

Educational Game

A game conducted to provide military commanders and executives with decision-making experience or to familiarise them with specific operations (or scenarios) and the associated problems.

Fantasy Game

A game in which reality is not necessarily completely simulated In reality, the RAF had inadequate numbers of Spitfires (and pilots) in the Battle of Britain. In a simulation, the 'what if' issue of different force levels can be explored, so a simulated RAF ORBAT may include 20% more Spitfires and pilots. In a fantasy game, the the RAF could have squadrons of F-15D Eagles and batteries of Patriot SAMs, LAZER cannon armed star ships or even the services of a fire breathing dragon. The best known fantasy game is 'Dungeons & Dragons'.

Free Game

A game in which the results of interaction between opponents are determined subjectively by the control staff, on the basis of experience and judgement, rather than by reference to an objective model (such as attrition equations).

Free-Form Game

A game in which there are as few rules as possible and players are free to make any decisions they wish, consistent with their resources and the game objectives. The player is not limited by 'constraints' (such as detailed rules that prescribe how and when everything must be done).

Manual Game

A game in which all functions (set up, movement, combat resolution and bookkeeping) are performed manually by the human participants. All outcomes are judged by the umpires, by reference to objective tables or their own judgement.

Military/Political (Mil/Pol) Game

A game that examines a military conflict or crisis, taking into account the full range of human factors (political, social, psychological and economic) impacting on overall national security policy.

Open Game

A game in which each player has all possible knowledge of his own and his opponent's situation. No information is witheld in an open game. The players have a 'god's eye view' of the game.

Rigid Game

A game in which the players' options are limited by rigid constraints (detailed rules) and all outcomes of interactions are determined by reference to pre-set tables, algorithms or models.

Strategic Game

See Mil/Pol game.

Game Control Group

One or more game participants whose tasks may include:

a. presenting problems to the players,

b. simulating the decision-making of any other individuals, organisations or nations whose actions are necessary to game play,

c. assessing the intermediate outcomes of players' moves, and

d. managing the game process itself.

In automated games, the computer performs these tasks.

Game Parameter

A measurable condition which is assumed to be constant, with respect to game time (eg: terrain).

Game Theory

A mathematical theory concerned with the choice between alternate courses of action by opponents, where the outcomes can be expressed mathematically.

Game Variable

A measurable condition which changes , with respect to game time (eg: weather, ambient light) or as a result of players' decisions and outcomes).

Gaming

The art of playing games. This includes the 'knack' of exploiting 'loopholes' in the rules to one's advantage.

Grain

The grain of a wargaming map is the direction in which the straight rows of hexes appear to run parallel. Movement and attacks are easier 'with the grain'.

Level

The range of echelons of military command which are represented by the players in a war game. Also, the lowest echelon of command which is represented by the players.

Level of Game

The largest formation on the side of principal interest whose play is required for the objective of the game. Most operational level land warfare games are at brigade or divisional level. Most operational level air warfare games are at squadron or wing level.

Line of Sight

A path of unobstructed vision between two hexes. In tactical wargames line of sight (LOS) is necessary for detection and engagement with direct fire weapons.

Methodology

The way that techniques and procedures are used in a game, study or analysis.

Model

A representation of a thing, event or system.

Analytical Model

A set of expressions that generally aggregates the actions it examines by means of mathematical relationship. Often used by an analyst with minimal computer support.

Force-on-Force Model

The depiction in a model of a two sided military engagement which plays all the principal factors having influence on combat.

Functional Model

The depiction in a model of a two sided military engagement in which only one functional element of combat is considered in detail.

Operational Model

A model that deals with force effectiveness. This includes analytical and force-on-force models.

Performance Model

A model that examines how a system performs the task for which it was designed. A performance model may be one sided or two sided, in which case it compares a single system to one or a few systems.

Monte Carlo Method

The use of random sampling procedures for treating probabilistic mathematical problems. It may involve a variance reducing technique, which screens out unrealistically high or low results.

Phasing Player

The player whose turn it is to move.

Play

A single run-through of a game. Also, used to represent replications of a game under a single set of starting conditions.

Player

A participant in a game who simulates the decision-making process of a designated group or organisation, usually at an executive level. In a war game, the players assume the roles of commanders and staff officers of military formations, on opposing sides.

Playing Team

A group of participants in a game whose task is as for a player.

Post Processor

A part of a computer game program that converts the raw data generated by a play into usable form, by means of statistical applications, ordered groupings, charts, graphs and tables.

Reality

A concept consisting of an infinite number of interacting variable processes. A specific part of reality can be portrayed by isolating a selected number of the variables. Past events (if accurately observed and recorded) can be modelled with greater accuracy than future events.

Red

The traditional identifying colour of enemy forces in a wargame. The Prussians originally used red to indicate the enemy in the 1830s, so it has nothing to do with communism.

Resolution

The basic units of force, distance and time used in a wargame. The level of detail.

Resources

The total capabilities of each force represented in a wargame, including manpower, firepower, mobility, command, control, communications, intelligence and logistics.

Routine

A major element of a model, consisting of an ordered set of instructions, that is frequently used.

Rule

An objective statement of the results of any given action or interaction between opponents in a game. A rule may be deterministic or probabilistic in nature.

Deterministic Rule

A rule that states precisely and uniquely the results of any action or interaction between opponents in a game.

Probabilistic Rule

A rule that states the results of any action or interaction between opponents in terms of a probability-density function. The result applied on a given occasion is determined by randomly sampling from the distribution generated by the probability-density function.

Scenario

The structure of a war game, giving the location, size and development of forces, doctrine to be used, environment and military tasks to be accomplished by each side.

Simulation

A technique used to study and analyse the operation and behaviour of man-machine systems, in terms of the elements of which they are composed. Simulation is an imitation of reality, which may include one or more of the following:

a. physical models (including mechanical or electrical),

b. mathematical or symbolic models, and

c. human operations.

These are interrelated and manipulated in such a way that there is correspondence with relevant characteristics of the 'real' system being studied. Conclusions can be drawn about the 'real' system by analogy.

Deterministic Simulation

A simulation in which the outcome is predictable and the element of chance is absent.

Probabilistic Simulation

A simulation in which the outcome is subject to chance variations. Also known as stochastic simulation.

Reinforcement Track

The schedule of reinforcements that a player may be given (subject to conditions) during the game.

Sequence of Play

The sequence in which players perform game functions. A typical sequence of play would be:

a. take reinforcements and replacements,

b. repair damaged units and bases,

c. check supply status of all units,

d. conduct pre combat reconnaissance,

e. move all units,

f. resolve all combats,

g. conduct post combat reconnaissance, and

h. exploit through breaches forced in enemy defences.

Stack

A group of friendly units placed in the same hex. Most games define stacking limits, for realism. Obviously, only so many troops, vehicles, vessels or aircraft can 'fit' into a given volume of space.

Stochastic Simulation

Probabilistic simulation.

Starting Conditions

Instructions and information given to players to initiate play of a war game. Usually includes :

a. statement of the mission to be achieved,

b. forces available,

c. boundaries,

d. intelligence appreciations, and

e. constraints.

Terrain Effects

The ruggedness and state (eg: dry, muddy, snow covered, etc.) of terrain influences mobility and the application and effects of firepower. The vegetation (eg: desert, tundra, savannah,

jungle, etc.) and man made terrain features (eg: canals, ditches, sand berms, minefields, fortifications, urban structures, etc) can have similar effects. These effects must be documented and made apparent to players.

Thinking Red

The art of thinking and behaving as the enemy would. Leaders and warriors from different cultural, racial, religious and/or political backgrounds have different value systems and different tolerances. They do not always respond in the anticipated manner.

Time

An infinitely flexible variable in wargaming.

Fast Time

Normal time is speeded up, so that events happen faster. A two hour engagement may be gamed in 30 minutes.

Game Time

The time/date of the problem and/or events being simulated in the game (eg: 25 June 1876 - Custer's Last Stand).

Real Time

The actual (real) time/date.

Normal Time

Events happen as in reality. A two hour engagement takes two hours to game.

Slow Time

Normal time is slowed down, so that events happen slower. A two hour engagement may take five hours to game.

Variable Time

The rate at which game time passes is varied, in a combination of the above rates. Significant events may be gamed in slow time, to give players more time for decision-making, while periods of insignificant activity are speeded up, to save the participants' time.

Training Model

A model that is exercised as part of a training program or course. The trainee interacts with the model, inputting guidance and receiving, from the model, combat results on the operation of his guidance on model logic.

Training Simulation

An interactive vehicle (manual or computer supported) through which command and staff elements are trained in the performance of battlefield missions.

Wargame

A simulated military contest, conducted according to rules, with participants in direct opposition to eachother or the game control group, without using actual combat forces. Usually two sided.

Zone of Control

The surrounding area (beyond that physically occupied by a unit) that a unit influences or controls. A hex upon which a unit is exercising an effective ZOC is called a controlled hex. Zones of Control (ZOCs) can effect mobility, combat, supply and retreat.

Zone of Control Effects on Mobility

Locking ZOCs. On entering a locking ZOC, a unit must stop and engage in combat before moving on..

Rigid ZOCs. On entering a rigid ZOC, a unit must stop and cannot move again till the next turn.

Elastic ZOCs. Units may enter and leave an elastic ZOC, but must pay an additional movement cost for the privilege.

Open ZOCs. Open ZOCs do not effect mobility.

Zone of Control Effects on Combat

Active ZOCs. Every enemy unit in an friendly active ZOC must be attacked.

Inactive ZOCs. No attack is mandated in inactive ZOCs.

Zone of Control Effects on Supply

Interdicting ZOCs. A friendly supply path cannot be traced through enemy interdicting ZOCs.

Suppressive ZOCs. A friendly supply path can only be traced through an enemy suppressive ZOC if the ZOC is physically occupied by a friendly unit.

Permissive ZOCs. Permissive ZOCs do not effect supply.

Zone of Control Effects on Retreat

Interdicting ZOCs. A friendly unit cannot retreat through an enemy interdicting ZOC. If the unit has no other retreat route, it is eliminated.

Suppressive ZOCs. A friendly unit can only retreat through an enemy suppressive ZOC if the ZOC is physically occupied by a friendly unit.

Permissive ZOCs. Permissive ZOCs do not effect retreat.