The Evolution of Military Simulations and War Gaming

Some would consider chess to be one of the earliest forms of war gaming.[1] Although the moves and rules in chess are abstract and not based on reality, chess does have some war gaming features appropriate to ancient times. These include: defined pieces (manoeuvre units) each with a fixed capability (mobility), defined starting positions (deployment), fixed terrain (the chess board), and turns with a time limit and poor command and control (represented by players moving only one piece per turn). These simple rules represent the fact that soldiers in ancient times had defined roles, usually deployed in lines at the start of a major battle, usually fought on clear ground and had limited control of their forces once the battle started. In the 17th century the first 'modern' war games appeared. Like chess, these early simulations were still rather abstract, but they now used real terrain representation and the playing pieces more accurately modelled contemporary military capabilities.

Throughout history men such as Sun Tzu, Machiavelli, Jomini and Clauswitz tried to formalise the theories and principles of war, and provide a 'formula for success'. These were almost all based on studying historical battles, looking for the common underlying reasons for success and then setting these out as principles to adhere to in future wars. These principles haven't always passed the test of time: changing culture, technology and size of the battlefield mean principles valid at one level of battle may not be valid at other levels. For example, Clausewitz, who was admittedly more interested in the philosophical aspects of war, stated that "defence is the stronger form of combat". From a common sense view point this would appear to be obvious and Clausewitz's principle has permeated military thinking for decades. Even today many authors believe a defending force should automatically suffer far fewer overall casualties. However, although defence may be stronger tactically, stubbornly maintaining a defensive posture or being forced to maintain a defensive posture, can be disastrous at the operational and strategic level. This has often proved to be the case historically, and especially during WWII.[2] Similarly, the often used phrase "attack is the best form of defence" has proved to be unfounded in modern mechanised war. The fact is that attack is only the best form of defence under certain conditions and depending on many factors which are not always readily apparent.

As these writings and philosophies developed, the professional military began to take more notice of war gaming as a proper military tool: it soon became apparent that with fixed principles plus a model of the real world (the simulation), one could predict the probability of success better than using purely qualitative (i.e. non-mathematical) analysis. In the early 19th century, the Prussians developed the first detailed and realistic war games.[3] The Prussian Army developed a series of war games from studying historical battles, and used them for training, planning and testing new types of military operations. Most military simulations during this period confined themselves to single battles, but later, entire campaigns were simulated. These enabled more sophisticated parameters such as transport and logistics to be modelled and practised. By the 1870s most European armies had identified the potential of military war gaming by examining the Prussian efforts, but none developed it to the same degree. No doubt the Prussian successes in the Franco Prussian Wars, and the phenomenal organisational abilities of the German General Staff in

[1] J. Dunnigan, The Complete War Games Handbook , William Morrow and Company, New York, 1992, p.146.
[2] Modern military simulations show that anyone 'playing' a campaign on the Eastern Front during WWII will find they suffer far more casualties if they stubbornly remain on the defence. The dictates and complexities of a modern mechanised war in open terrain mean the defensive force suffers disadvantages which often result in higher overall losses. For example, the defensive force is far more subject to massive operational losses, which are losses not resulting from direct combat. This is because defensive forces are more subject to encirclement by the opposing mobile forces (which generally also maintain the initiative). In addition, temporary losses due to breakdowns, unserviceable equipment etc, are far more likely to become total losses due to capture by the attacking (and hence advancing) enemy.
[3] J. Dunnigan, The Complete War Games Handbook , William Morrow and Company, New York, 1992, p.146.

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relation to logistics in the first world war, were to some extent attributable to their prowess at war gaming.[4]

By World War II the German Army had developed war gaming to a standard where almost every major offensive operation was simulated to assess the chances of success, to iron out unforseen factors, examine logistics and to develop contingency plans. The Army conducted war games, sometimes referred to as “map exercises”, at theatre, army group, army and panzer group levels.[5] The form of these manual simulations was very similar to the more sophisticated board games of today. Operation Barbarossa was no exception, and at the beginning of September 1940 Lieutenant-General von Paulus took over the co-ordination of all preparatory work of the Army General Staff involved in preparing an operational plan for Barbarossa.[6] His report used information from operational studies by Marcks and von Loberg.[7] On 23rd November 1940 the first war game to test Soviet responses was ready. These and other war games continued through December 1940, testing logistics, terrain, strength of required forces etc. In addition to General Staff war games, Army Groups conducted their own tests. Between 9th and 10th April 1941, Army Group Centre HQ at Posen (under von Bock) conducted major war games, primarily focused on how to ensure the bulk of Soviet forces in the Western Military District were to be prevented from withdrawing.[8]

The Soviets, British and Japanese also used war games in World War II, and war gamed many major offensive operations. Surprisingly, the US Army initially lagged behind the other major powers in this field, and only the US Navy regularly used military simulations.[9] Probably the most famous Soviet war game in the pre-Barbarossa period was carried out in the first week of January 1941. The war games were organised under the supervision of Defence Commissar, Marshal S.K. Timoshenko and Chief of the General Staff, General K.A. Meretskov. The war game was to test if an ‘Eastern Force’ commanded by Colonel-General D.G. Pavlov (representing the Soviet Army), could halt an attack by a ‘Western Force’ commanded by General Zhukov, in the area north of the Pripet Marshes. The aim of the war game was to show that the Eastern Force would be strong enough to halt the Western Force, and then to launch a successful counter-offensive. The war game turned out to be a major victory for the Western Force, which launched three powerful breakthroughs and destroyed the bulk of the Eastern Force. Stalin was so annoyed that he dismissed Meretskov and replaced him with Zhukov.[10] This incident reveals how seriously war games were taken by the Soviets, and it’s a pity Stalin (and the Stavka) took more notice of the people involved than the actual results of the war game. It comes as no surprise to serious war gamers that almost all the Soviet and German war games, conducted in the six months before Operation Barbarossa, produced similar results to the historical result from June to August 1941.

In the post-war period the major developments in military simulations involved the application of computers, and developments in the areas of operations analysis and systems analysis. The constraint of manual (map based) simulations has always been the limited number of

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[4] L. Hart, History of the First World War, Papermac-Macmillan Publishers Ltd, London, 1997, pp. 29-30.
[5] R.H.S. Stolfi, Hitler’s Panzers East, University of Oklahoma Press, Norman, 1991, p. 84.
[6] J. Erickson, The Road to Stalingrad, Phoenix-Orion Books Ltd, London, 1998, p. 7. Also, H. Boog, et al. (German Research Institute for Military History at Potsdam), Germany and the Second World War, Volume IV: The Attack on the Soviet Union. Oxford University Press, New York, 1996, p. 275.
[7] H. Boog, et al. (German Research Institute for Military History at Potsdam), Germany and the Second World War, Volume IV: The Attack on the Soviet Union. Oxford University Press, New York, 1996, pp. 257-276.
[8] R.H.S. Stolfi, Hitler’s Panzers East, University of Oklahoma Press, Norman, 1991, pp. 85 and 86. Refer to Part VII – ‘Complete Computer Simulation of Operation Barbarossa: 22nd June TO 31st December 1941- Historical and Current Results of War Gaming Operation Barbarossa’ for discussion of the results of the German pre-Barbarossa war games. In brief, the outcome of these tests indicated the bulk of the Soviet Western Front could be destroyed west of the Dnepr River (as occurred historically), and they do not generally support the view in some quarters that Operation Barbarossa was fundamentally flawed by inadequate logistical planning.
[9] J. Dunnigan, The Complete War Games Handbook , William Morrow and Company, New York, 1992, pp. 234-235.
[10] J. Erickson, The Road to Stalingrad, Phoenix-Orion Books Ltd, London, 1998, pp. 8 and 9.

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manual calculations that could be performed per turn and storing the 'status' of each unit over time. For example, manual simulations require the movement allowance, readiness, supply state and strength after combat, of each manoeuvre unit to be calculated and stored for each turn. If there are thousands of units then the simulation requires tens of thousands of calculations per turn, and millions of calculations per campaign. The result is that tactical (map based or board) war games tend to focus on small areas and fewer units, while operational or strategic war games tend to have large scales, large manoeuvre units with limited numbers of 'value steps', and long times frames per turn.

The development of computers meant the calculation rate and dynamic data storage could be dramatically increased: every unit's readiness, supply, combat damage, movement allowance, etc, could be calculated every minute if need be. Furthermore, far more sophisticated combat models could be implemented with many more factors included, and the interrelationship between parameters could be fully simulated. For example, when a unit moves it losses some readiness as the unit dispersion increases and some equipment is lost due to breakdowns. The readiness loss is a function of the transport available, distance moved, terrain, weather, and supply and support infrastructure. The computer can almost immediately calculate the readiness loss for each kilometre moved, while still taking into account all these variables. In most manual war games 'unit readiness loss due to movement' is simply not simulated, although some use abstract rules to partially represent these effects.

At this time (the 1960-70s) military simulations started to suffer from the same illusion plaguing other complex system modelling: namely that with massive computing power and brilliant mathematical theory, military simulations should be able to exactly predict outcomes of future battles and campaigns. As time has passed we have realized that operations and systems analysis may not be as reliable and accurate as once hoped, although it can still be relatively precise. Experience and further developments in disciplines involving data analysis (eg data warehousing), has shown that not every aspect of any 'real world' system can be simulated or predicted. This has led some commentators to denigrate mathematical modelling as a tool in general, and specifically to say that military simulations cannot predict outcomes with certainty. However this argument is feeble and disingenuous because only God can predict anything with certainty! All mathematically based tools used for analysis and prediction, do not need to model with absolute accuracy or predict certain outcomes. If a military simulation (historical or otherwise) achieves even a 50% solution in terms of predicting the details of a battle's outcome, then it is still well ahead of any qualitative based analysis using 'educated' guess work. The problem of accuracy in military simulations remains a trade off between the complex nature of war, and the availability of time, resources and computing power.

Today (map based) manual war games are not considered precise enough for the needs of the professional military. It is apparent however that history based manual war games, although relatively imprecise in some aspects, still achieve a 70-90 % solution. This is accurate enough to be useful and still provides a far more accurate historical account of a battle or campaign than a purely qualitatively bases analysis. The advent of ever more powerful PCs and combat models, means the millions of calculations per turn can be done relatively quickly. This does not necessarily mean exact outcomes can be predicted, but pursuit of the '99 percent solution' is possible today.[11] This of course, assumes 'intelligence received' is up to the required level if planning a future campaign, or 'historical research' is up to the required level if analysing a historical campaign. The reader can be sure that the 1990 Gulf War and the 2003 invasion of Iraq were war gamed, and that the Coalition commanders had a very good idea of their chances of success with their chosen strategies.

Today, the use of military simulations and war gaming generally falls into one of four main categories. They are:

[11] J. Dunnigan, The Complete War Games Handbook, William Morrow and Company, New York, 1992, p. 236.

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1. Prediction of future outcomes, with or without data from historical battles (mostly military professionals).
2. Training personnel in combat techniques, logistics and command and control (military professionals).
3. Prediction of possible different outcomes of historical battles and campaigns, and hence the study of military strategies (and mistakes) from the past (military professionals, amateur war gamers and other military history authorities).
4. To study history by studying the assembled research data, without actually playing a war game (mostly history scholars and military history enthusiasts).

The focus of this work is on the last two categories (above): specifically using the techniques and methodology of military simulation to study in detail the first six months of the largest and costliest military campaign in history, namely Operation Barbarossa.

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