Digital War (2020) 1:138–143
https://doi.org/10.1057/s42984-020-00004-z

ORIGINAL ARTICLE

Virtual paradox: how digital war has reinvigorated analogue wargaming

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Published online: 26 March 2020

Abstract
War has become increasingly digital, manifest in the development and deployment of new capabilities in cyber, uncrewed and remote systems, automation, robotics, sensors, communications, data collection and processing, and artificial intelligence. The wargames used to explore such technologies, however, have seen a renaissance of manual and analogue techniques. This article explores this apparent paradox, suggesting that analogue methods have often proven to be more flexible, creative, and responsive than their digital counterparts in addressing emerging modes of warfare.

Keywords Wargaming · Kriegsspiel · Technology · Warfare · Digital gaming · Analogue gaming

Warfare has become increasingly digital. Militaries around the world are developing, deploying, and employing new capabilities in cyber, uncrewed and remote systems, automation, robotics, sensors, communications, data collection and processing, and even artificial intelligence. The wargames used by governments to explore such technologies, however, have seen a renaissance of manual and analogue techniques. What explains this apparent paradox?

This article will explore three reasons why analogue gaming techniques have proven useful for exploring digital war: timeliness, transparency, and creativity. It will then examine how the field of professional wargaming might develop in the years ahead. To contextualize all of that, however, it is useful to discuss wargaming itself. How and why militaries use games to understand the deadly business of warfare?

On wargaming

For as long as there has been warfare, there have been games of war (van Crevald 2013). Some of these, such as polo or jousting, have their roots in martial exercises and practice for combat. Others, such as chess, were general games of strategy that made little or no claim to accurately represent warfare.

Modern, professional wargaming—that is, the use of serious games to train officers, develop doctrine, analyse problems, and assess plans—has early nineteenth-century origins, rooted in the application of mathematics (von Hilgers 2012) and the increasingly scientific study of warfare. Drill books prescribed rates of march and fire. Military architects undertook a detailed analysis of angles and fields of fire. In what can be considered early operations research, armies tested the accuracy of cannon and measured the number of hits obtained by muskets against targets at various ranges. Such early "digitization" of manoeuvre and firepower made it possible to mathematically model how formations might manoeuvre and inflict damage on each other.

It was in this context that, in 1812, Prussian officer George Leopold von Reisswitz invented *kriegsspiel*: a tabletop game intended to model warfare through the representation of units, capabilities, and terrain. The system was then revised and more fully developed by von Reisswitz's son, Georg Heinrich Rudolf Johann von Reisswitz, in 1824. When shown to General Friedrich Karl Ferdinand Freiherr von Müffling, the Prussian Chief of the Staff reportedly declared: "this is no ordinary sort of game, this is schooling for war. I must and will recommend it most warmly to the army" (Caffrey 2019, 17).

This later version was indeed recommended for use throughout the Prussian military. The game was played on accurate topographical maps, with movement scaled

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appropriately. Combat was resolved through a system of data tables, dice, and the determination of odds. While not digital in the modern sense of the word, it certainly depended fundamentally on the ability of a wargame designer to render the complexity of manoeuvre, firepower, technology, and casualties into mathematical relationships. War had, on the tabletop at least, become a set of algorithms.

Early on, two poles of wargame adjudication emerged (Schuurman 2017): "rigid kriegsspiel" (wherein outcomes are determined by written rules, tables, and charts) and "free kriegsspiel" (wherein outcomes are determined by knowledgeable umpires). Most of the debate revolved around issues of realism, simplicity, and playability. In free kriegsspiel, players and games are less encumbered with complex rules and time-consuming procedures. However, umpires might bring their own personal biases to adjudication process. In more rigid games, formal rules can be built on research and the known performance of formations and weapons systems. However, rigid rules can only address circumstances that are envisaged by the game designer before the game is played. Free adjudication, on the other hand, allows a game to address anything, including novel, innovative, or otherwise unanticipated game actions. It is, as we shall see, a difference of approach that has continued relevance into the digital age.

This article will not survey the subsequent development of wargaming, which has been well covered elsewhere (Allen 1989; Perla 1990; Caffrey 2019). Suffice it to note that it became an increasingly commonplace tool of military planners and educators through the nineteenth and twentieth centuries.

History suggests that wargaming is most effective when undertaken regularly and integrated into professional military education. The example of the US Naval War College during the inter-war years is cited in this regard, with such games doing much to influence the development of new approaches at a time of technological and geopolitical change (Lillard 2016). Wargames have also proven especially useful when the elements of subjective "game" and scientific operations research were productively combined. The work of the (predominately women) wargamers of the Western Approaches Tactical Unit during WWII, for example, had a major effect on the Battle of Atlantic by combining gameplay, qualitative and quantitative data collection, statistical analysis, and the training of naval officers (Williams 1979; Strong 2017; Parkin 2019). Wargame practitioners stress the need for wargames to be designed with appropriate attention to analytic methodology and be situated in a broader cycle of research (Bartels 2019; Compton 2019; Pournelle 2019; Perla et al. 2019).

Through the Cold War, the digital revolution made its mark on both warfare and wargaming. Computers could undertake the modelling of combat effects much faster, and with much more sophistication, than humans ever could. While manual techniques continued to be favoured for POL-MIL (political military) wargames where group interaction and decision-making was a central focus, the computer-assisted simulation and modelling of war came in some quarters to be seen as preferable to the older analogue methods. At the same time, user interfaces were becoming more realistic and effective. Increasingly, aspects of military training took place in synthetic environments, such as flight simulators.

In the meantime, hobby wargaming—which had reached a zenith in the 1970s using either maps and cardboard or miniatures and scale terrain—would be eclipsed by digital games of war, either strategy games (such as *Civilization* or the *Total War* series) or first-person shooters (such as *Call of Duty*).

By the early 1990s, manual, analogue wargaming had atrophied across Western militaries. There was little or no wargaming in many professional military education programmes. Course of action (COA) wargaming, intended to evaluate tactical military plans, was often just a series of scenario discussions. Similarly, much analytical wargaming had devolved to BOGSATs ("bunch of guys/gals sitting around a table") that were little more than group seminars. Within operations research, formal/mathematical modelling and computer simulation seemed to have eclipsed wargaming, which was seen by some as difficult to replicate, idiosyncratic, and thus unscientific.

Yet as the new millennium dawned and the digital age accelerated, wargaming would enjoy a revival. Perhaps, the most obvious indicator of this was a February 2015 memo by then US Deputy Secretary of Defence Robert Work (2015) which called upon the Department of Defence to reinvigorating its wargaming capacity. It is worth quoting at length, given Work's emphasis on technology, innovation, and the changing nature of modern warfare:

> I am concerned that the Department's ability to test concepts, capabilities, and plans using simulation and other techniques—otherwise known as wargaming, has atrophied. To most effectively pursue our third offset strategy, avoid operational and technological surprise, and make the best use of limited resources, we need to reinvigorate, institutionalize, and systematize wargaming across the Department. Reinvigorated wargaming across the defense enterprise fits within the Defense Innovation Initiative, which aims to bolster the credibility of US security guarantees at home and abroad through innovative and agile thinking and actions.
>
> Military-relevant systems and technologies are changing quickly, and new tactical and operational challenges are intensifying and proliferating, all during a period of

> fiscal pressure. During similar periods of technological and geostrategic flux, wargaming proved to be a useful tool for both improving our understanding of complex, uncertain environments and the changing character of warfare. When done right, wargames spur innovation and provide a mechanism for addressing emerging challenges, exploiting new technologies, and shaping the future security environment.

The "third offset" here refers to the Pentagon's intention to exploit emerging technologies to gain a strategic edge over adversaries—thus highlighting the degree to which wargaming was seen as a way of helping the America navigate the challenges of digital war (Norwood and Jensen 2016). Work and General Paul Silva (then Vice Chairman of the Joint Chiefs) later declared that "we are living in a time of rapid technological change and constrained defense spending, not unlike that of the inter-war years. Successfully navigating through this complex and dynamic competitive environment will once again require us to push the boundaries of technology while ensuring that innovation remains rooted in operationally realistic doctrine and capabilities. One way to do both is to re-prime and re-stoke the department's wargaming engine." (Work and Selva 2015).

There followed a series of initiatives, including a "wargame repository" that would collect information on past and pending games, the allocation of greater resources, and establishment of a Defense Wargaming Alignment Group to assure that priority issues were being addressed (Work and Selva 2015). A number of other US allies also followed suit. In 2017, the Development, Concepts, and Doctrine Centre (DCDC) of the UK Ministry of Defence published its own *Wargaming Handbook* (2017), which noted, among other things, the value of gaming for understanding how "science and technology might deliver a competitive advantage" and "exploring innovation in the art of war".

Interestingly, while the *Handbook* pointed to the value of digital gaming, most of the examples provided were either computer-assisted manual game or fully analogue ones. Wargaming professionals have repeatedly highlighted the utility of manual and analogue gaming techniques to explore cutting edge issues like cyber (Downes-Martin 2018).

There are three main reasons why analogue gaming methods—most of which would have been comprehensible to the nineteenth-century designers of kriegsspiel—can be useful for examining "digital war". These are, as noted at the outset, the speed of manual wargame design, the value of transparency, and their role in fostering creativity.

Digital delays and analogue adaptability

Digital war is characterized by rapid action and reaction. Information flows around the world in fractions of a second, through the Internet and across the electromagnetic spectrum. Data are processed ever more quickly. The speed of digital decision-making drives advances in automation and artificial intelligence.

However, digital wargames are slow and expensive to develop. They can cost millions of dollars and months or years to design and implement. Because they are difficult to modify—this typically involves rewriting or adding code—there is necessarily an extended period in which requirements must be established. As additional features are added in, costs mount. In some cases, these costs can be limited by using (modified) commercial off-the-shelf hobby games, or by developing civilian and military versions of the same game, but that not always a viable option given the requirements of military training or analysis.

Digital wargaming is also highly platform-dependent. Software designed for one operating system may be all but unusable in a matter of years, either forcing users to maintain legacy systems or abandon it. Getting one set of digital simulations running on one set of systems to communicate with other simulations running on other systems can also be a difficult and expensive challenge. In the 1990s, the US military developed a Joint Simulation System (JSIMS) to address this, but the $69 million development cost eventually ballooned to almost a billion dollars (Caffrey 1989, 139).

By contrast, analogue systems tend to be much quicker and easier to design and very much cheaper to modify. In some cases, changes in game systems can be made in a matter of minutes, using little more than pen and paper, or word processor and printer (Brynen 2015).

As Caffrey (2019) notes, when wargamers were designing simulations centred on the Soviet Union and its allies, design speed was of less importance. New Soviet weapons systems came with long development times, the implementation of technological change was generally incremental, and doctrine was slow to change. Wargames could thus be developed at a similar pace. Today, technological change has accelerated, threats and actors are more complex and diffuse, and hence games need to be developed or modified much more quickly. A recent RAND survey of thirty-two US and allied wargaming centres found "there was movement away from POR [Program of Record—that is, DoD-financed, generally digital] tools due to issues such as lack of flexibility. Manual games were continually in use regardless of what other technologies centers were exploring and were considered to have significant pragmatic advantages" (Wong et al. 2019, 39).

Game mechanics and the problem of digital "black-boxing"

Digital gaming allows for sophisticated modelling through the interaction of large numbers of variables. Interfaces can be increasingly visual and immersive, including now the employment of virtual reality. Modern combat simulators represent the most common application of this, with flight or vehicle crews having served up a synthetic experience of the world which they can interact in real time. Gaming cyber adds a new twist: if testing the defence of or attacks on complex network infrastructures, for example, it can be useful to have a simulated digital infrastructure against which to test techniques and exploits. For that reason, many countries are developing "cyber ranges" in which IT professionals can test and hone their hacking/counterhacking skills.

In digital games, however, algorithms are embedded in software code—and hence are not visible to the user. Such "black-boxing" has two related effects. First, players may not be clear why certain outcome happened because the cause-and-effect relationships are not apparent. Second, it means that players are in a weaker position to interrogate and challenge the underlying model.

In manual games, by contrast, the rules and adjudication of outcomes are typically a simpler but much more transparent process. This may make for better learning and also may more easily sustain a critical conversation about assumptions, causes, and effects.

The problem is aggravated if the apparent technological sophistication of digital simulations and interface is accepted as evidence that the underlying models are necessarily correct. As one 1991 RAND study on combat modelling presciently noted, increasingly levels of technological enthusiasm and computational power could actually obscure serious shortcomings in the models upon which wargames were built—a "base of sand" as Davis and Blumenthal (1991) termed it. Without attention to this, advances in digital wargaming could result, as Caffrey (2019) notes, in obtaining "the wrong answer faster and with more persuasive graphics". This is a problem that has been identified in other fields too, ranging from architecture to the sciences (Turkle 2009). It is particularly challenging when wargaming the implications of emerging technologies, precisely because so little is known, and underlying models are thus tentative at best.

Given that wargames intended to explore the cutting edge of "digital war" are addressing military and sociopolitical techniques that are new and not yet fully understood, manual games may often be preferable to digital ones precisely because they are better able to engage the players into thinking about these issues in a critical and innovative way. This is especially true with games that deal with broad strategic challenges, or which examine the social and political effects of digital engagement—issues like social media usage, digitally enabled election interference, or the ramification of automation and AI.

Fostering creativity

The differences between "rigid" and "free" kriegsspiel have already been noted. Purely digital wargaming, in which permissible actions and their effects have been embedded in algorithms and computer code long before the players first start playing, lies at the most rigid end of the adjudication spectrum.

Because digital war involves the application of emerging technologies in novel ways, however, it is an area in which innovation is key. This is true, moreover, both for dominant actors and for lower technology adversaries seeking to counter technological advantages. Manual techniques allowing for an element of free adjudication are better able to accommodate this. One (manual) wargame undertaken to explore the impact of emerging technologies on combat, for example, saw Blue's robotic weaponized vehicles defeated by an opponent who used children, equipped with blankets and spray paint, to blind the vehicles' sensors (Brynen 2018). A digital game would have been extremely unlikely to have "children" and "blankets" encoded into game options. In the analogue game, however, the Red player simply informed the umpire of their actions, which were then adjudicated on their merits.

Precisely because of the growing salience of digital war, as well as the equally uncertain dynamics of asymmetrical and hybrid conflicts, recent years have seen the growing popularity of "matrix games", a sort of freeform, narrative wargame which lacks the determinacy of a previously established ruleset (Brynen et al. 2017). Instead, actions are taken by simple arguments ("I will use X to do Y, with desired effect Z"), which are then discussed by the participants. The odds of success are determined based on this group discussion, and these are then used to determine the outcome. Matrix games can be often be designed in a few days (or less) and played in half a day. While they lack detailed granularity, they do allow for—indeed, encourage—a great deal of innovative thinking (Curry et al. 2018). Ironically, however, their very simplicity can prove a drawback in the digital age. Even if they can be very useful tools for exploring cutting edge issues (Engle 2018, 219–236), they may look too simple, too cheap, and too, well, "analogue" to impress some senior officials—regardless of their actual utility (Brynen and Mouat 2017). In the age of digital war, digital expectations may sometimes hamper creative approaches.

Towards next-generation wargaming?

As the US Marine Corps invests in its future wargaming capabilities, it has sought to outline a vision of what it terms "Next-Generation Wargaming" (NGW). Recent work on this vision provides insight into how wargaming is likely to evolve in the age of digital war.

Specifically, the Marine Corps has called for "a wargaming art and method that will seamlessly represent an evolving operational environment and accommodate the agility, imagination, and speed of innovative thought" (Lademan 2017). A subsequent RAND study on NGW (Wong et al. 2019) emphasized the value of more fully utilizing digital technologies, in order to create a more engaging and immersive environment for participants—especially a generation that had come to expect sophisticated graphics and visual display from commercial console and computer gaming. As the report notes, "NGW aims to incorporate emerging aspects of gaming among millennial and Gen Z gamers to evolve the current paradigm of wargaming—both in terms of technology and methodology" (Wong et al. 2019, 30).

While RAND suggested that continuous "no-turn" adjudication (rather than the turn-based approach used in most traditional manual games) might involve "relying on a computer-based simulation model or artificial intelligence" (Wong et al. 2019, 31), their study had surprisingly little more to say on the subject of more fully integrating current advances in AI into wargaming. Moreover, neither the RAND nor the Marine Corps study suggested that manual gaming techniques were becoming obsolete. Quite the contrary, the latter was careful to note "while NGW will attempt to employ the latest technologies (i.e. scenario, decision, collaboration, adjudication tools), NGW is not about technology but about facilitating, synthesizing, and assessing the process of human decision making which drives the wargame" (Lademan 2017).

In short, "next-generation wargaming" appears to involve a diverse mix of digital and analogue approaches. Much of the focus is not on replacing manual and analogue techniques with wholly digital ones, but rather using the latter to foster more effective analogue play.

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