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Wargames and the future of decision making

Abstract

The ability to make decisions is not only innate, it can be trained, but how to do so has never been a trivial matter: Can a firm and solid decision theory be constructed? Are the skills that make a good decision-maker transferable? Wargames have historically been an effective tool for exploring these questions.

The latest advances in artificial intelligence have given wargames a new lease of life and have substantially facilitated game support functions. However, their application in agents and assistants for choosing a course of action raises difficult questions. Can automatic agents solve some of the problems afflicting current methods of training and evaluating decision-makers—and specifically, wargames?

At the same time, the growing community of civilian players—whether in the field of e-sports or board games—offers collective intelligence and a massive and diverse testing ground, whose dynamics can be exploited. A diversified source of cognitive profiles relevant to the analysis of decision-making performance.

The analysis shows that at the intersection between wargames, artificial intelligence and civilian players, an unprecedented opportunity arises: to rethink how we train, evaluate and expand decision-making capabilities. Likewise, three lines of operational action are proposed: the establishment of comparable metrics between different types of decision-makers, the gradual integration of automatic agents and

the structured incorporation of the civilian community through collaboration mechanisms.

Keywords

Wargames, Tecision-making, E-sports, Civilian players, Automatic agents.

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1 Introduction

The RAND Corporation defines wargames as analytical games that simulate military aspects at the tactical, operational or strategic level (RAND, n. d.). Their purpose is to examine the effectiveness of doctrines, train military commanders and analysts, explore scenarios, evaluate plans and possible courses of action (CoA), as well as their impact and consequences.

The use of wargaming is as old as war itself, with roots dating back to playful and ritualistic practices in various ancient and classical civilisations. However, its widespread use and formalisation as a systematic tool for training and strategic analysis originated in the military command centres of Prussia in the early 19th century, with the popularisation of Kriegsspiel (Caffrey, 2000).

Since then, wargaming has gone through cycles of boom and innovation—associated with volatile, uncertain, ambiguous and complex environments—and relative neglect – associated with periods of perceived stability. An illustrative example is the use, during the Cold War, of wargames as an essential element in planning nuclear scenarios, assessing deterrence doctrines and escalation processes in the context of a mutually assured destruction environment. In contrast, after the collapse of the Soviet bloc, its use declined in many military structures, displaced by a complete reliance on linear predictive models and established doctrine.

For obvious reasons, the 21st century, and especially the last decade (Work, 2015), has brought them back to the forefront. The growing complexity of today's conflicts—characterised by hybrid domains, asymmetric threats and accelerating change—highlights the need for tools that enable our decision-makers to explore the uncertain, anticipate the improbable and train adaptability. Their return is not simply a revival of past methods, but an adaptive reconfiguration in response to the demands of the present. Wargaming has evolved from an instrument reserved for military use to a versatile tool for navigating the complexity faced by organisations of all kinds, including civilian ones.

2 Methodology and scope

This essay is an analytical-conceptual narrative documentary review aimed at examining the current limitations of wargaming and its interaction with two variables: (i) automatic agents and (ii) civilian gaming communities.

Although not systematic, the selection of sources was made according to criteria of thematic relevance, authority and topicality. It should be noted that, although criteria of institutional diversity were applied, most of the contributions included are of Anglo-Saxon origin. This concentration responds to the objective dominance of research centres, military organisations and universities in the contemporary production of prospective literature on wargaming, and not to a deliberate restriction of the framework of analysis.

This is a flexible process that does not aim to be exhaustive, but rather to identify recurring patterns, structural limitations and opportunities for integrating variables that are in principle external to the world of wargaming. This approach provides an explicit and appropriate methodological framework for achieving the stated objective of the manuscript: to offer a structured synthesis and carry out a prospective exercise together with an action plan for the future.

3 Types of wargames and associated advantages

In 1962, the *United States Army Strategy and Tactics Analysis Group* (STAG, currently part of *the Centre for Army Analysis*) proposed a taxonomy of wargames according to their purpose (Roberts, 1962), which remains fundamentally valid today. They highlighted the following non-exclusive categories:

- Operational or analytical wargames: designed to test both the decision-maker (their skills, problem-solving abilities, analytical thinking, among others) and current doctrines. They are usually modelled on current elements and contexts that can be easily recognised by the player (organisations, equipment, tactics, etc.).
- Training or educational wargames: the objective is to facilitate learning in the decision-making process, understanding of a specific topic, historical event or doctrinal concept. They tend to simplify complex systems to focus on the desired lessons.
- Research or experimental wargames: these aim to analyse or evaluate new concepts, doctrines, alternative courses of action, etc., and are less factual and more speculative in nature.

In this context, as Perla and McGrady (Perla and McGrady, 2011) postulate, the practice of wargames offers multiple advantages. Although the category of wargame will determine the degree to which each of the stated objectives is achieved, the analytical exploration of new courses of action, the identification of opportunities for improvement and deficiencies in current doctrines, the modelling of new processes, and the anticipation of the consequences of certain decisions in safe environments are particularly noteworthy.

However, probably the most controversial aspect is the advantages that wargaming brings to the participants or players themselves. Improving the ability to understand and generate situational awareness, increasing critical and adaptive thinking, and superior decision-making skills are some of the proposed benefits. Unfortunately, these aspects are difficult to verify without a comprehensive and solid theory of decision-making.

Although the academic consensus (Sabin, 2014) suggests that wargaming is far from being a mature theoretical discipline, much has already been written on the subject, as well as on the use of technology and, in particular, Artificial Intelligence (hereinafter AI) in this type of process. This article, however, aims to focus on something more specific: (i) with regard to wargames, on the effects on the decision-maker, (ii) with

regard to the use of AI, exclusively on the role of automatic agents, and (iii) in the prospective field, on the impact that the contrast with the civilian player community would have on both types of players (military and automatic agents).

4 Limitations and problems of wargames

Before exploring how automatic agents and the civilian player community can help overcome some of the main limitations of wargames, it is worth first explaining what set of problems we are referring to. Without attempting to provide an exhaustive list, the main limitations and problems that wargames present today are (Grossman, 2023; Curry, 2020):

– The problem of modelling reality: this can be summarised by the statement that reality is too complex to be modelled and systematised in the form of a game. The process of designing a game abstracts characteristics of reality—like any model—which can result, at best, in an ineffective wargame and, at worst, in a pernicious wargame.

  It could be argued, however, that all decision-makers interpret reality through mental models, which are also subjective and simplified abstractions. The problem, therefore, is not that wargames are simplifications, but how and by what criteria these models are constructed[1].

  On the opposite side of the same problem, a high level of detail and realism reduces the repetitiveness of the game and limits it to a specific context and theatre of operations. This makes it difficult to generalise lessons learned and synthesise conclusions that can be extrapolated to other situations and codified in the form of new doctrines.

– The problem of input quality: as in any other information processing system, the quality of the output depends on the quality of the input. In the case of wargames, this translates into the relevance, diversity and richness of thought of the participants.

  When exercises are restricted to homogeneous player environments—primarily military—the game's ability to generate disruptive ideas, challenge established doctrine, or open up spaces for strategic innovation is also limited. The lack of cognitive diversity impoverishes the results and reproduces biases already present in the organisational structure.

  In this sense, wargaming must take all precautions associated not so much with simulation tools as with deliberative forums, where different perspectives can be confronted and generate novel solutions or creative disruptions.

– The problem of immersion: another fundamental limitation lies in the emotional disconnect between the decision-maker and the consequences of their decisions

1 At this point, it is necessary to consider whether, in the event of misalignment, it is desirable to push the wargame to adequately contain the player's decision-making framework, or to push the player's mental models towards the reality that the *wargame* aims to reflect.

on the field of action during the practice of a wargame. By transferring decision-making to a simulated environment, the impact of incidental emotions, which play a fundamental and recognised role, as described in various studies on general decision-making models (Lerner *et al.*, 2015), is reduced. Numerous authors, such as Rubia (Rubia, 2000) and Damasio (Damasio, 2011), argue that reason, far from being independent, is deeply mediated by emotional processes that systematically influence the assessment of risks and rewards. The rational weighing of alternatives cannot be understood independently of affective processing.

This emotional disconnect does not imply that decisions made in a wargame are qualitatively worse or less rational—one could argue just the opposite—but it does force us to recognise that they can never completely emulate the psychological conditions surrounding real decision-making. This problem profoundly qualifies the usefulness of wargames as educational and learning tools, while it does not significantly impact their use in improving and creating new courses of action.

– The problem of evaluation and feedback on results: a critical and often underestimated limitation is the difficulty of rigorously evaluating the results of a wargame and extracting systematic lessons. Wargames, unlike simulations, are essentially narrative and qualitative in nature, which differentiates them from systematic and purely quantitative tools. Many exercises lack robust ex-post analysis mechanisms to identify what has been learned about the doctrines and courses of action employed by the players or to what extent doctrinal hypotheses have been tested.

  Without clear structures for observation, conclusion and incorporation of lessons learned, wargames can become aesthetically appealing but epistemically sterile events. The lack of objective evaluation criteria makes it difficult to distinguish between valuable insights and mere lucky improvisations by the player. This limits their usefulness for designing new doctrines or improving procedures in operational environments. If we wish to support the legitimacy of wargames as an analytical tool, it will therefore be necessary to provide them with these observation structures, as well as mechanisms for the traceability and replicability of players' actions and their results, without compromising the social elements that make them distinctive and useful.

– The problem of the lack of a decision theory: finally, we must mention a structural deficiency which, although not exclusive to wargames, profoundly conditions our ability to evaluate their effectiveness and impact on the player: the absence of a solid, empirically validated theory of decision-making.

  Today, there is no established standard or scale that allows for the objective measurement of a decision-maker's ability, beyond the subsequent analysis of the consequences of their actions within the narrow framework of *the* wargame played. Without a robust theory, the assessment of the effectiveness of a wargame—and the improvement in the skills of its participants—is subject to informal criteria. Only intuition justifies some of the advantages we highlighted and which are perceived by those who practise the activity.

We refer to a model similar to those used for assessing IQ, for example, the Wechsler scale (Coalson, Raiford, Saklofske and Weiss, 2010). Different scales have been developed to assess specific cognitive elements that are fundamental to the gaming process, such as fluid intelligence, working memory, verbal working memory, social performance, mental flexibility and attention span. However, we do not have any similar element that integrates these abilities into a theory for decision-making in real contexts.

This gap has been pointed out by various experts (Banks, 2024) and represents an active line of research, especially in leading centres dedicated to the study of security or socio-economic decision-making[2]. Some pioneering projects, such as those developed by Carnegie Mellon University[3], have begun to exploit the role of AI in social decision-making (AI-SDM, short for *Artificial Intelligence Social Decision Making*). The growing number of publications and citations in this area in 2024 demonstrates the interest and expansion of this field.

These limitations do not invalidate the value of wargames as an analytical, educational or experimental tool—the three dimensions mentioned above—but they do highlight the need to rethink their design and, in particular, to determine the role that AI or civilian players can play in addressing some of these problems in a novel and effective way.

5 The role of Artificial Intelligence

5.1 Beyond automatic agents: simulations and use cases

One of the most common misconceptions when discussing AI in the context of wargames is its identification with simulation or data modelling systems. Although they share certain structural elements—scenario representation, rules of action, complex variable processing, attribution, etc.—these are tools with essentially different purposes and foundations (see table 1).

Simulations (e.g., those used for logistics prediction, operational planning, or conflict evolution) seek to replicate, with the greatest possible degree of accuracy, the behaviour of real systems: there is no problem with modelling reality; they seek to capture and reproduce it with the highest level of detail. Their logic is that of mathematical approximation, calibrating models with historical data, refining algorithms and equations, and offering probabilistic outputs. They do not aspire to explore decision spaces; the focus is on the result and not on the process, on prediction and not on deliberation, improvement of doctrine or learning by the decision-maker.

2 See: https://www.mors.org/Communities/Communities-of-Practice/Wargaming and https://idm.uni.edu/about-us/overview

3 See: https://www.cmu.edu/ai-sdm/

Compared to the openness and unpredictability of a wargame, simulations are deterministic. Integrating simulations into specific functions of a wargame, such as award processes, can enrich the game, but implementing them in decision-making processes jeopardises the very essence of the wargame (Compton *et al.*, 2025).

In the field of AI, the range of use cases it offers for *wargames* is very broad (Knack and Powell, 2023). In this regard, we can highlight:

Tabla 1: Comparación entre *wargames* y simulaciones

Característica	*Wargames*	Simulaciones
Propósito	Entendimiento de la complejidad y de la toma de decisiones humanas	Generación de datos, predicción de resultados
Competencia	Explora la interacción sistémica y el mecanismo causal	Proporciona probabilidades y simula condiciones
Aproximación	Centrada en el humano, iterativa y con un foco cualitativo	Basada en datos, algorítmico y con foco cuantitativo
Nivel de abstracción	Alto, estratégico o operacional	Bajo, táctico
Foco	Entender el "por qué"	Predecir el "qué"
Validación	Compleja, requiere juicio experto y diseño de escenarios	Complicada, pero susceptible de verificación cuantitativa

Figure 1. *Source*: author's own elaboration, based on Compton et al. (2025)

- Applications in wargame design: content generation, scenario generation, etc.
- Applications in game execution: opponent simulation (red cell), adjudication process, assistants for choosing a course of action, etc.
- Applications in game analysis: identification of key interactions, behaviour modelling, assessment of the decision-maker's accuracy, etc.
- Logistical applications: real-time translation, transcription of player dialogues, etc.

Particularly interesting—and therefore the focus of this article—are advances in agent modelling for game resolution and decision-making. This is what the Alan Turing Institute (Knack and Powell, 2023) describes as high-risk, high-reward applications, or what Davis and Bracken (Davis and Bracken, 2022) call long-term ambitions for AI-enhanced decision-making: assistants for choosing courses of action and simulating opponents[4].

4 We therefore focus on the application of assistants in *wargames*, but it should be noted at this point that it is not necessary to move around a board (and face the problem of modelling reality) in order to take advantage of AI in the decision-making process. In the field that deals with reality without abstraction, indeterminate or of unknown determination, it is called *decision-making under deep uncertainty* (DMDU). The objective, in this case, is not to optimise our CoA, but to find strategies with good results in the wide range of circumstances that an uncertain future represents.

5.2 Automatic agents: what are they and why are they important?

Regarding the first question, what are automatic agents, it should be noted that we are referring primarily to optimisation agents: systems capable of deciding and making inferences with the particularity that they learn from their observations of their environment.

Unlike traditional expert systems[5], which are based on pre-parameterised rules such as 'If A occurs, do Y' or 'If (A and B) occur, do Z', automatic agents do not rely exclusively on their a priori knowledge. Their strength lies in their ability to evaluate the different options available to them and choose a strategy or action not only because the inference rule indicates it, but because they can estimate, using a function (usually called a value or utility function), the degree of proximity of each option to the objectives pursued.

In the case of expert systems, the world is a state machine that is as simple or complex as the number of rules you have been able to parameterise. If the system encounters a situation for which it has no defined rule, it will be unable to decide. Automatic agents, however, do not need to capture reality through a set of rules. On the contrary, the utility function allows us to assess any situation, the possible actions to be taken and the possible states to be transitioned to, without the need to know them exhaustively in advance.

The relevance of utility functions is that they work well with uncertainty, and we can load most of the decision-making process into the state we know for sure, the current state. But how do we know which future states to apply these utility functions to? That is precisely what Markov decision processes do[6].

If we add machine learning engines to reweight our decision-making process, we have achieved a concrete description of a simple system: a reinforcement learning model. And if the learning engine is based on deep learning techniques, the term applied is deep reinforcement learning (see figure 1), one of the most promising fields of research in the world of AI.

Gráfico 1: Modelo esquemático de un sistema *Deep Reinforcement Learning*

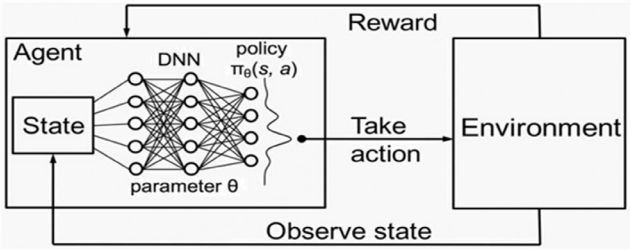

Figure 2. Source: Mao et al. 2016

5 An expert system is a system that aims to simulate human reasoning, in the same way that an expert in a field of specialisation would. They are fundamentally divided into rule-based systems, case-based systems and Bayesian network-based systems.

6 A Markov Decision Process is a procedure that occurs in non-deterministic environments or environments with a certain degree of uncertainty, using a state transition function to calculate the probability of reaching a new state when performing an action on the current state.

The paradigm is simple in its formulation but powerful in its implications: an agent faced with an infinite number of states that make up its environment anticipates the usefulness of the different states it can transition to (reward) based on the available actions, makes decisions (take action) and then adjusts its decision parameters using machine learning mechanisms. Through this continuous cycle of action and feedback, the agent progressively refines its performance.

Regarding the importance of automatic agents in game theory—and, by extension, in wargames—it is relevant to note that the scientific community's efforts to 'solve'[7] games using these agents is not arbitrary, nor is it based solely on a certain competitive component of performing tasks previously considered human using computers. Huge amounts of money are rarely invested for reasons not based on operational objectives and, as shown by Stanford's *Artificial Intelligence Index Report* (Nestor *et al.*, 2024), investment is growing in the private sector and skyrocketing in the public sector, particularly in defence departments. The application of optimisation agents to games is clearly more than just a passing fad.

'Transferability' is the key word. A paradigmatic example is Alphafold, DeepMind's deep reinforcement learning-based AI capable of predicting the protein folding process—with revolutionary implications for biology—which would not have been possible without AlphaGo. Agents that solve games are agents that can be applied to solving other problems, and depending on the characteristics of the games solved (e.g., Go, with a very complex field of action), the range of problems to be addressed will be more or less broad. This is known as the transferability and generalisation property of deep reinforcement learning.

Returning to the nature of games, we highlight three characteristics that will largely determine how simple or complex it will be to produce automatic agents that play at a superhuman level: (i) complexity of the field of action, (ii) real-time play, and (iii) complete/incomplete information play.

In games with complete information and differentiated turns, regardless of the complexity of the field of action, such as chess or Go, agents have long since surpassed the best human players. In real-time environments with high complexity of the field of action and incomplete information, characteristic of many video games such as *Starcraft II*, automatic agents are already at a level similar to that of the best humans. AlphaStar, also from DeepMind's Alpha series, reached the 'Grand Master' level in 2019. OpenAI, for its part, achieved comparable performance in *Dota2*. These achievements show that, under the right conditions, automatic agents not only reach but exceed the human level in strategic decision-making games.

How would an agent specifically designed to play wargames behave? As we have seen, achieving superhuman agents is not a technical issue; we can do it regardless of the characteristics of the game. It is a question of the business case being profitable,

7 When we talk about 'solving', we are really referring to tackling the problem at a superhuman level, not what is technically understood as a 'solved game' in game theory.

which brings us to the contingency of wargames and the absence of a firm decision theory, a clear benchmark for comparing the capacity of decision-makers and, particularly in this case, the usefulness of wargames as a training and competition tool. A search for the aforementioned transferability of capabilities with the aim of closing the gap between the decision-maker in the wargame and the decision-maker in a real theatre of operations. Is it possible to generate automatic agents capable of choosing superior courses of action, outside of traditional doctrine, and with greater speed and consistency?

Kofford, from DARPA, summarises the rationale behind research in this line of work (Freedberg, 2023):

> 'I'm a chess player, and there's a lot to learn from chess AI. Modern chess engines can not only beat human players, but they can also help them by analysing their games, commenting, and advising on better moves. Similar AI tools for warfare help commanders and their staffs to plan a military operation'.

In short, automatic agents can be understood as adaptive decision-making systems, capable of learning from their environment, anticipating consequences, and optimising their actions based on defined objectives. Their value lies not only in outperforming humans in certain games, but in their ability to transfer that performance to broader and more complex domains: from wargames to the theatre of operations. Without forgetting that this is the ultimate goal, these agents are also ideal for addressing several of the limitations and problems of wargames that we have outlined above, from the problem of modelling and diversity of thought to the difficulties of evaluation and the absence of a consolidated theoretical framework for decision-making. Below, we will explore how automatic agents can contribute to mitigating these problems and enhancing wargaming as a tool for learning and strategic analysis.

5.3 Contribution of automatic agents to mitigating the problems of wargames

Based on the limitations and problems of wargames, which we discussed earlier, we propose the following areas for improvement, derived from different ways of integrating automatic agents into the process:

– Support for modelling reality: the use of automatic agents allows the design of wargames with multiple actors/players without proportionally increasing the number of human participants, which makes wargames with more dimensions (economic, social, cybernetic, etc.) viable, reflecting a more complex and richer reality and chain of interdependent decision-making processes. In addition, agents can help mitigate some of the cognitive or institutional biases that contaminate design proposals, such as overconfidence or the tendency towards the *status quo* and a preference for 'acceptable' rather than optimal outcomes in the definition of the rewards associated with each action.

- Generation of cognitive diversity: one of the main limitations of wargames is the homogeneity of participants. Agents can be trained with different heuristics, strategic styles or deliberate biases (e.g., aggressive, conservative, exploratory, etc.), thus simulating a plurality of decision profiles that enriches scenarios and broadens the spectrum of outcomes.
- Design of adaptive and non-deterministic opponents: compared to the predictability of human opponents in simple environments, or doctrine-based scripts, automatic agents introduce dynamic adversaries that learn, adapt and explore new strategies. Unconstrained by cultural, hierarchical or doctrinal inertia, agents can identify and test unconventional strategies, contributing innovative ideas and thus broadening the spectrum of options available for strategic reflection and potential improvement of the decision-making process. Additionally, this increases the uncertainty of the game, enhances the sense of immersion and forces decision-makers to face unexpected dilemmas.
- Exhaustive and transparent tracking of the decision-making process: agents allow each step of their reasoning to be recorded and analysed—actions considered, utility assessments, discards and final choices. This level of traceability provides extremely valuable material for comparing processes, identifying biases and feeding structured feedback, traditionally one of the weaknesses of wargames.
- Unfortunately, when we talk about deep learning as a learning engine, we incorporate into the equation the well-worn problems of explainability, replicability and reliability that affect, in general terms, most AI solutions. The foreseeable rise of 'Causal AI' over the next few years may prove crucial in this regard.
- Comparative evaluation of human performance: agents can serve as a benchmark against which to evaluate the decisions of human participants. This comparison makes it easier to distinguish effective decision-making styles from ineffective ones, identify recurring error patterns and provide more objective feedback, overcoming the reliance on subjective or narrative judgements.
- Contribution to the construction of metrics and decision theory: the use of agents generates large volumes of structured data on decision-making in simulated environments. This data can be used to develop comparable metrics and, potentially, to cement a more robust theory of decision-making, thus filling the current gaps in the field.

Apart from the general problems associated with AI (we have already mentioned some, such as the difficulties posed by the problem of explainability in tracing the decision-making process), there are also specific pitfalls on the horizon for its application to wargames, notably:

- The problem of trust in the agent: overvaluing the courses of action proposed by the agent can cause the human decision-maker to assume as their own decisions that are the product of a hallucination or a poorly modelled situation. In general, the level of scrutiny of automatic decisions may be lower than that of human decisions, particularly if the causal chain is not understood.

- The problem of decision ethics: by definition, automatic agents are utilitarian, as are their utility functions. It is impossible to imbue them with categorical imperatives. Accepting the courses of action proposed by these agents can lead to ethical and moral dilemmas.
- The problem of attribution of responsibility: related to the previous problem, an automatic agent cannot be held responsible for the courses of action it proposes, so these decisions and their consequences are entirely attributable to the human in charge of the process (human-in-the-loop). This problem becomes more apparent when we leave the sandbox of our wargame and try to transfer the doctrine to the real world. To what extent would the decision-maker be willing to take these courses of action if they are unable to fully understand them?
- The problem of behavioural differences between automated and human agents: the learning of human decision-makers—it should be remembered that the effects on the decision-maker are the focus of our analysis—in wargames may not be entirely useful, given that the automated agent may exhibit clear behavioural differences. In the words of Parasuraman and Riley (1997), using automated systems can distort learning: humans are good at interpreting the intentions and patterns of other humans, but we have difficulty anticipating or understanding the behaviour of automated systems (giving rise to what the authors end up calling 'automation surprises'). There is a risk that, instead of acquiring generalisable learning, the human decision-maker will over-adapt to playing against automated agents.
- The training set problem: training these types of agents is very intensive in terms of the need for data and games. Synthetic training sets—generated by the agents themselves—reduce variability and affect the quality of learning.

6 The role of board games and e-sports

6.1 Untapped potential

If automated agents represent the technological side of the effort to overcome the limitations of wargames, there is a second, equally promising dimension: the civilian community. Parallel to advances in artificial intelligence, the growth of the civilian gaming community—from board game enthusiasts to e-sports professionals—has created an ecosystem with as yet largely unexplored potential for research and decision-making training. These environments offer not only a massive and diverse testing ground, but also a living laboratory of playing styles, creativity and coordination in highly competitive contexts. In this sense, analysing the role of board games and e-sports allows us to understand how the collective intelligence and distributed talent of civilian players can complement and enhance what automatic agents bring to wargames.

Any proposal for a comprehensive decision-making theory considers a set of cognitive components that form part of wargaming practice: fluid intelligence, working memory, verbal working memory, social performance, mental flexibility, and attention span, among others. These are exactly the same components involved in board games and e-sports.

With the growth in the practice of these games, interest in knowing what effects they have on cognitive abilities has also increased, and what was intuitively assumed is beginning to be proven: the improvement is real, in the same cognitive components that mediate in wargames. Furthermore, the benefits seem to be more pronounced the more demanding the difficulty factors already described for automatic agents are: real time, complexity of the field of action, and incomplete information. Based on these criteria, e-sports lead the way in cognitive gains (Martinez *et al.,* 2023):

> '[…] the findings demonstrate that play time predicts players' cognitive performance. It seems that video games affect cognitive performance more than board games do, which has never been demonstrated in previous studies. The unique features of this main game type surely explain its specific relationship with cognitive functions. Video games seem to have a greater potential for overall cognitive enhancement because they involve processing various types of information and adapting strategies dynamically and in real time'.

In the same way that speed training strengthens the lower body and in turn partly determines the athlete's overall performance, it is very likely that these cognitive components are not only impacted and improved, but also determine the ultimate quality of the human decision-maker. In short, these are transferable skills: what improves performance in a complex game also has an impact on other decision-making domains.

From this perspective, it is reasonable to expect that a competitive civilian player—whether a professional e-sports player or a board game expert—will perform well as a decision-maker in wargames. The transferability of the skills that make a human decision-maker brilliant remains a field of enormous potential, still largely unexplored and even less exploited.

6.2 Contribution of civilian players to mitigating the problems of wargames

Many of the limitations of the two domains mentioned above (wargaming and the contribution of automated agents to them) seem potentially solvable or, at least, mitigable with other approaches that incorporate civilian players:

- Support for wargame design and modification: tabletop and e-sports players bring practical experience in complex rule environments, emergent dynamics, and interaction systems that is extremely valuable for designing more robust games. They can help identify imbalances, introduce innovative dynamics and improve gameplay without sacrificing realism, thus helping to reduce the problem of static, oversimplified or biased modelling in accordance with current doctrine.
- Contribution to a comprehensive theory of decision-making: the widespread practice of strategic games provides empirical evidence on how the cognitive abilities involved in decision-making are developed and transferred. This wealth of data and experience offers fertile ground for advancing towards a more robust theory of

decision-making, overcoming the current lack of comparable metrics in wargames. Civilian players function as a natural field of experimentation.

– Diversity of thought and playing styles: we have already highlighted the cognitive diversity generated by agents, but in the case of civilian players, we have a human community that is diverse in age, gender, education and cultural background. This heterogeneity introduces variability in strategic styles, risk appetite and sensitivity to different dilemmas. In practice, this enriches wargames, reducing group bias and bringing creativity to decision-making processes, something difficult to replicate with automated agents without large amounts of training.

  As the literature on military innovation points out, many of the most significant doctrinal advances have emerged thanks to perspectives introduced by external actors who question established assumptions, revealing conceptual gaps and opening up new lines of tactical-operational adaptation (Millet y Murray, 1996; Biddle, 2006). Therefore, when civilian players participate in wargames—and often outperform professional military personnel—a very useful creative tension is generated between the old rules and the new tactics, prompting officers to constantly question and refine what they think they know.

– Generation of large volumes of non-synthetic data: both competitive board games and e-sports naturally produce massive databases, full of human decisions in highly competitive contexts. This material is an extraordinarily valuable resource for training, validating and stressing automatic agents, which normally depend on artificial data. In contrast, this data presents the real cognitive variability of human decision-makers, providing behavioural patterns that cannot be reproduced using synthetic data, which allows the behaviour of agents to be brought closer to the real complexity of the decision.

– Bridge between human decision-makers and automatic agents: civilian players, due to their utilitarian and competitive approach, occupy a middle ground. They lack the emotional immersion of military decision-makers, but they introduce human creativity and adaptability that automatic agents do not yet possess (it is impossible not to think of *Ender's Game* here). In this way, they act as a kind of 'missing link' that facilitates both the understanding of how agents learn and the validation of their performance.

– Element of comparison and competition: civilian players allow metrics to be established for comparison with military decision-makers by introducing human rivals with high strategic capacity in controlled game conditions. Competition, as has been demonstrated in other sporting and cognitive fields, acts as a powerful driver of continuous improvement. For wargames, this means providing an environment in which both humans and agents can be measured objectively, stimulating constant improvement.

  Institutions such as the Modern War Institute at West Point (Moran and David, 2022) have long studied the need to improve military decision-making and the potential benefits of contrast and competition with civilian players (gamers), such as improved speed, the incorporation of aseptic or dispassionate approaches, and the prevalence of informed intuition:

'Military officers realised that "their speed of decision-making was lacking compared to gamers with greater intuition and skill". This connects to real military concepts such as the OODA loop (Observe, Orient, Decide, Act), where faster decisions give you a huge advantage'.

7 An action plan for the future

Once both the problems and the potential solutions that automatic agents and civilian players can bring to the state of the art have been outlined, it is easy to sketch out a development roadmap for the future. The goal is to fit the pieces of this 'puzzle' into a roadmap that allows for orderly progress.

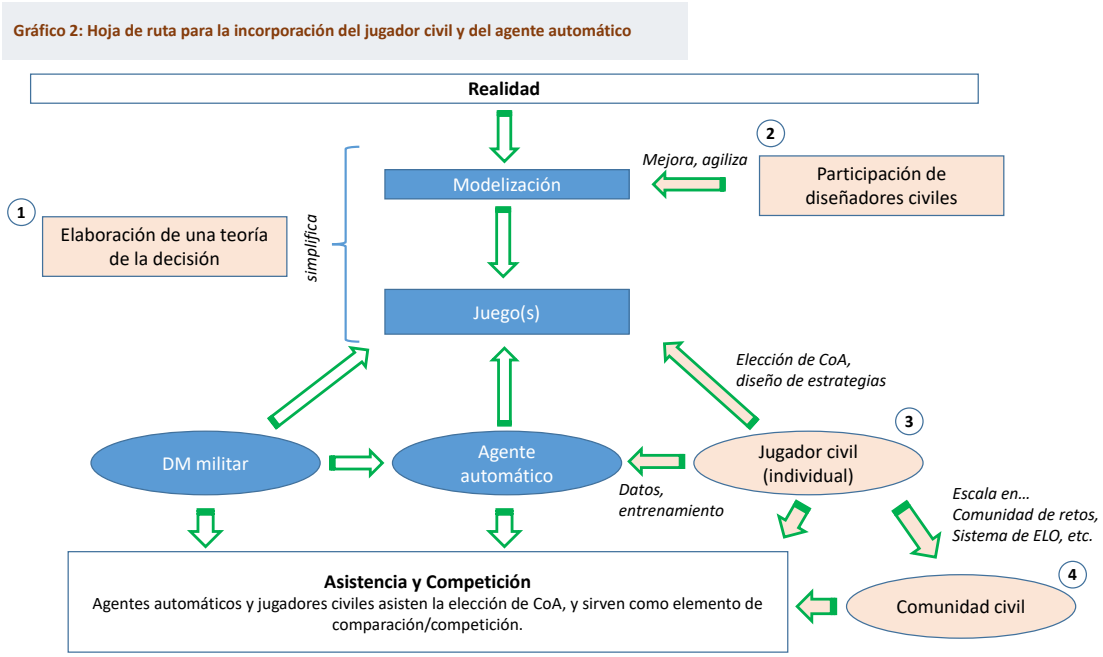

Figure 3. *Source*: author's own elaboration

In view of the above:

1. Development of a decision theory: the first step is to consolidate the foundations on which wargaming is based. The absence of a solid decision theory currently limits the ability of human decision-makers to evaluate and compare. Without attempting to resolve this structural deficiency, it is possible, in the field of wargames, to:
   - Isolate the cognitive abilities that are part of the decision-making process.
   - Weigh their relative importance according to different contexts and levels of uncertainty.
   - Develop comprehensive assessment scales that allow us to measure not only isolated capabilities, but also the overall performance of the human decision-maker as a complex cognitive system.

   This step involves laying the foundations of the intended cathedral, providing wargaming with a more solid conceptual and methodological basis.

2. Participation of civilian designers: at the same time, it is advisable to open the field to designers with experience in board games and *e-sports*. Their expertise in balance, game dynamics and user experience can:
   - Increase the production capacity of wargames, expanding the design pipeline.
   - Improve the quality, appeal, and challenge that these games pose for human decision-makers.
   - Introduce mechanical innovations that help overcome the problem of overly rigid modelling.
3. Civilian player participation: Civilian players—particularly competitive or professional ones—can gradually become part of the wargaming ecosystem, contributing in three key areas:
   - Generation of high-quality training data for automated agents, based on thousands of conveniently recorded human decisions.
   - Comparison and direct competition with military decision-makers, establishing objective metrics that promote continuous improvement.
   - Assistance in choosing courses of action and exploring alternative doctrines.
4. Civilian community participation: in a final stage, the active involvement of the wider community of players can be sought in order to harness their collective intelligence. Some examples are:
   - Open and collaborative challenges: if decision theory remains unconsolidated and wargames remain specific and contingent products, specific challenges open to the community can be designed, following 'Capture the Flag' models.
   - Gamification and professionalisation: if sufficiently abstract and generalisable wargames can be designed, they can be gamified and distributed, creating a competitive scene with ranking systems (dynamic Elo) through prizes and incentives. This would make it possible to identify civilian decision-makers with exceptional talent, amplifying the impact of the third point.

It is easy to draw up highly disruptive scenarios when the three driving forces—(i) decision theory, (ii) AI applied to *wargaming,* and (iii) the incorporation of civilian gaming—advance in a joint and coordinated manner. At that point, wargaming would cease to be solely a military training tool and become a global decision-making laboratory, where human creativity, the power of AI and the diversity of the civilian community would mutually reinforce each other.

8 Atlantic, European and Spanish doctrinal context

As part of NATO, Spain participates in an alliance that is very active in strategic innovation, where wargaming is a central formative and forward-looking element. Of particular note are the contributions of Allied Command Transformation (ACT),

which leads the Audacious Wargaming initiative[8], whose objective is to develop its own capacity within the framework of wargaming to explore strategic futures, stimulate critical thinking and experiment in controlled risk environments. As its name suggests, it is the organisational structure responsible for the most daring aspect of wargaming, which has a long tradition in the alliance and is currently very active[9], also through the Allied Command Operations (ACO).

At the European level, the European Defence Agency (EDA) was a pioneer in organising joint *wargames* in its field, although its efforts now seem to be focused on promoting simulation and modelling programmes such as the Integrated European Joint Training and Simulation Centre (EUROSIM).

In the Spanish context, although there is no visible or structured official doctrine like that of other European countries (UK Ministry of Defence, 2017; Bundeswehr, 2024), we do have a recently created reference point in the EMAD wargaming centre, both in terms of developing the activity and promoting it (for example, with the holding in 2024 and 2025 of wargaming conferences aimed at personnel from the Army, Navy and EMAD agencies). Particularly noteworthy is the involvement of the academic community in the centre's initiatives (Faculty of Education and Psychology of the University of Navarra), which facilitates the alignment of efforts not only towards the design of more effective wargames, but also towards the comparative metrics we propose in this essay.

On the analytical side, CESEDEN actively works on research into both *wargames* and the integration of emerging and disruptive technologies (EDT), particularly AI, and the convergence of these two lines of research is also frequently referenced in the centre's publications (Garat, 2024). In terms of integrating the academic and civil communities, CESEDEN's activities are channelled through collaboration agreements involving the university world, such as the Almirante Juan de Borbón Chair[10].

9 Conclusion

The incorporation of civilian players and the development of automatic agents applied to wargames should not be understood as alternative approaches, but as complementary dimensions of the same problem. While agents provide adversary simulation capabilities, adaptability and systemicity in the exploration of courses of action, civilian players introduce cognitive diversity, creativity and empirical data that enrich the training and validation of models. The convergence between the two approaches opens up the possibility of designing more rigorous and useful wargames and training decision-makers more effectively. An ecosystem where artificial

8 See https://www.act.nato.int/wargaming/ for more information.

9 See https://www.act.nato.int/activities/win24/ for more information.

10 See https://www.ucm.es/catedra_juan_de_borbon/ for more information.

intelligence and collective intelligence—civil and military—mutually reinforce each other, shaping a new horizon for research and practice in decision-making in complex environments.

Throughout this essay, a progressive action plan has been proposed that begins with the consolidation of a decision theory applicable to wargaming, continues with the integration of civilian designers and players, and culminates in the creation of a new strategic learning ecosystem. This roadmap must be translated into concrete operational lines that allow progress towards its implementation, beginning with:

1. Developing a system of metrics to compare decision-makers: regardless of whether they are military, civilian or automated agents. The usefulness of wargaming will increase significantly when it is possible to evaluate the performance of the decision-maker objectively and consistently. To this end, it is necessary to move towards a cross-cutting metric architecture that allows decisions and decision-makers to be compared. These metrics should evaluate aspects such as consistency under uncertainty, exploratory capacity, risk management, adaptation to demanding time frames, pressure situations or different scenarios (games).

   Given that this architecture is the operational dimension of decision theory yet to be developed, it will require institutional collaboration: agreements with universities specialising in cognitive psychology or other related fields such as data science applied to decision-making, as well as joint research programmes.

2. Progressive and controlled integration of automatic agents in wargames: they must be incorporated following a phased roadmap, defined in advance, until opponents are simulated. In the first phase, their role in support functions should be explored in depth: allocation and estimation of consequences, logistics or traceability of the decision-making process to improve *ex post* analysis. From there, agents should be trained in simplified wargames that allow parameters to be adjusted without the cost of operating in a complete environment. The next step could be their gradual introduction as assisted adversaries.

   This may require the creation of an institutional 'sandbox', where collaboration with applied research centres, in this case AI and computational game theory, can take place. Outside the academic world and unlike the operational front line, the technology industry, which has been working with AI for years in the development of adversarial agents for video games, would also have an important role to play here.

3. Structured integration of the civilian community: the incorporation of the civilian community—tabletop gamers, independent designers, wargaming communities, competitive e-sports players—can be articulated through concrete steps and mechanisms designed to generate operational, analytical and training value from the outset.

   First, it would be necessary to map talent, a preliminary 'cognitive catalogue' to guide calls for proposals and pilot programmes. This does not seem a complicated

task, as these groups are identified, segmented and highly motivated to collaborate if we are able to define the incentives appropriately. From this starting point, agreements should be established with clubs and associations to form stable groups that participate in iterative cycles of wargaming and specialised tournaments, with the aim of both collecting training data and identifying high-cognitive-performance players. Some ideas for these tournaments will include not only the confrontation of different types of decision-makers, but also wargames with mixed teams to analyse the tension between innovation and doctrine; or alternative doctrine days led by civilians.

In parallel, it would be desirable to establish a collaboration programme with independent publishers and designers, focusing on mixed design workshops, early validation of game mechanics and the transfer of design methodology from civilian to military.

Many of the skills involved in decision-making are transferable. Recognising this reality means abandoning prejudices and accepting that new generations of players possess, in certain cognitive aspects, a remarkable level of skill. It would be a missed opportunity to ignore this potential; integrating it, on the other hand, opens the door to a future where wargaming becomes a meeting place for technological innovation, human talent and methodological rigour.

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