Force Design Using A.I., Digital Engineering, and Wargaming: Sports Insights

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ABSTRACT

Military force composition analysis is complex, and decisions can take a substantial time and resources to operationalize and possibly more to change. However, modern warfare is characterized by rapid adaptability to competition. The reconciliation of these differences can be aided by Artificial Intelligence (A.I.). Much of the research focuses on developing A.I. agents capable of winning games. This paper takes a different approach by focusing on applying A.I. to system-of-systems level decision making, as this approach is being used outside the defense industry. Specifically, by looking at how professionals in sporting use A.I. in games to assess component level contributions to success, this paper lays out how Digital Engineering and Wargaming can be used to train an A.I. that can optimize force composition and prepositioning decisions across conflicts. Sports and military competitions both require team members to collaborate to complete their collective objectives and overcome opposing teams. Like force composition and prepositioning of assets for military conflicts, sports teams need to determine their formation and lineup with the goal of defeating an opponent. This paper proposes using a digital environment to ensure data capture and force restructuring in wargames are scalable and accessible to A.I. Previously, emergent properties and other confounding variables made it challenging to determine what makes one lineup or formation better than another. However, this paper will demonstrate how, by learning from wargames, A.I. can optimize force composition and prepositioning decisions. What is interesting is, just like in professional sports, that an "underdog" can today use existing A.I. tools to increase their chances of victory, making it a potentially disruptive technology if only one side deploys it to win a game or conflict. Given the potential impact (as demonstrated by professional sports), we propose immediate work begin on the implementation of these A.I. systems in wargaming.

ABOUT THE AUTHORS

Matthew Bowler is an operations research analyst with Booz Allen Hamilton. He works with clients to create digital engineering solutions to optimize force composition. Additionally, he analyzes the effectiveness of current systems and future concepts against projected force requirements in specific mission contexts. He is primarily committed to the development of the Advanced Battle Management System. Matthew holds a Mechanical Engineering B.S. from Brown University.

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Brian Hall is the founder of AlphaPlay A.I., a company dedicated to optimizing outcomes and decision-making in global professional sports through artificial intelligence (alphaplayai.com). In his spare time, he teaches at New York University on analytics, machine learning and artificial intelligence topics. Brian regularly speaks on applied, innovative uses of A.I. in industry, including at the MIT Sloan Sports Analytics and SABR Analytics conferences. Prior to joining the NYU faculty, Brian worked at Two Sigma Investments, a New York City-based hedge fund primarily known for its use of artificial intelligence. He is also the founder of the SABR Artificial Intelligence and Machine Learning Committee.

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INTRODUCTION

Overview

The exponential growth of digital technologies presents both an opportunity to tackle age old problems in new ways and a risk of falling behind competitors who adopt technological advancements first. The recent evolution of Artificial Intelligence (A.I.) is particularly noteworthy. For some time, A.I. has dominated humans in games previously thought to be too complex for A.I. to successfully compete (Berner et al., 2019). As a result, modern elite players now train with and learn from A.I. strategies to improve their own strategic thinking and increase their chances of winning against human opponents (Fridman, 2022). The elite players who do not learn from A.I. are apt to fall victim to human biases and be unprepared for styles of play developed by A.I. (Fridman, 2022). Although using A.I. to act as a decision maker in warfare is already being explored, there remain many niches for novel A.I. systems to aid human decision makers in warfare.

Optimizing the positioning and composition of forces is an essential niche of warfare that is especially difficult due to the unpredictable nature of conflict and the changing Operational Environment. In positioning warfighting assets or developing a force laydown, one must determine the most effective allocation of resources for a variety of missions. In optimizing force composition, one must determine the capabilities required to accomplish the commander's intent. These two aspects of warfighting can be directly compared to aspects of sports. Force laydowns are analogous to a professional sports team's starting lineup. A manager must determine how to best position his players and their respective capabilities based on strengths and weaknesses across a field to defeat an opponent. Optimizing force composition is analogous to optimizing a team's roster. Both entail identifying and developing key capabilities required to find success against a variety of opponents in variant conditions. These clear similarities in the needs of decision makers in sports and warfighting elucidate the opportunity to apply advanced techniques from one field to the other. This paper will explore how an A.I. model developed for professional sports could be trained using digital engineering techniques in wargaming scenarios to empower decision makers to better optimize the laydown and composition of their warfighting assets.

Study Importance

By applying A.I. technology to force laydowns and force composition development, decision makers can help maintain a decision advantage over adversaries who are growing in strength (Schmidt, 2022). Taking advantage of the advancements made in other sectors is part of the growth of the defense industry. With the flexibility of A.I. models, sectors such as the professional sports industry, are now important to survey and collaborate with to discover creative solutions to shared problems. This paper will demonstrate the relevant overlap and value to be gleaned from A.I. advancements in the sports industry.

The rapid evolution of warfare makes it challenging to develop systems that can provide advantages before they are irrelevant. The A.I. system deployed in professional sports that is discussed in this paper allow users to draw insights from data from a variety of sources. This capability will help to bridge the gap between Intelligence Community's red and blue force information making this data more actionable. Additionally, by developing a digital infrastructure for wargaming, models can be further trained in a simulated environment.

A digital environment built to capture wargaming data would reduce the cycle time currently plaguing many wargames. Without such an environment, insights from a given wargame must first be converted into a specific data format to be ingested by modern analysis tools. An understanding of the wargaming process and modern A.I. models is necessary for developing an environment that appropriately captures key data for training models.

Scope and Examination Method

This paper will discuss how A.I. techniques utilized in professional sports are impactful and relevant by drawing comparisons to force laydowns and capability development.

ISSUE

History

Military resources are not infinite; commanders must make decisions both about what assets to enlist and where to position them. For each of these decisions there is an opportunity cost. If an F-35 is purchased that might mean one less F-22 or hundreds fewer drones. Similarly, placing a PATRIOT battery near one base means it is unavailable to defend another. This difficult balancing act extends to achieving multiple centers of gravity while maintaining long-term operationality and survivability. It is impossible to prepare for everything, so commanders and planners must make decisions about where to position resources. Additionally, decision makers should be wary of cognitive biases, such as overvaluing highest tech assets or the most visceral aspects of a kill chain (weapons or delivery platforms), a bias that A.I. has been able to exploit against chess players over-valuing powerful pieces as we will discuss later in this paper (Fridman, 2022).

Considering all aspects of the kill chain is becoming more common through System of Systems (SoS) and Mission Based Systems Engineering (MBSE) approaches. “It’s imperative to focus on lethality and the ability to win, regardless of whose individual weapons system is best” (Uppal, 2023). By studying the components of each participating entity throughout the entire kill chain, including third party supporting platforms, requirements can be derived at the mission-level. For instance, using a multitude of cheap drones with specific Intelligence, Surveillance, and Reconnaissance (ISR) capabilities might be more beneficial to the success of a long-range kill chain than increasing the payload of a missile. This framework also provides traceability, while maintaining the rigor and comprehensiveness needed (Power et al., 2018). These problems, force composition and placement, can require an immense amount of information and decision making. This is only increasing as capabilities and operations become more complex and networked.

Societal Impact

As cited by MAJs. Klein and Nimmons, leaders tend to prioritize developing one detailed plan as opposed to plans that account for multiple, branching potential Courses of Action (COA) due to time-constraints (Klein and Nimmons, 2017). Additionally, “Hyperwar,” a term to describe the nature and speed of warfare under the influence of A.I. as coined by GEN(R) John Allen and Amir Hussain, speaks to ever-shorter time and the need for A.I. mastery to maintain a competitive edge (U.S. Army TRADOC G2 Mad Scientist Initiative, 2017; Allen and West, 2020). As automated decision making and action execution become more prevalent, human decision makers will need to be able to rely on these tools to stay competitive. By introducing a method for A.I. utilization in the planning and deployment phases that provides transparency to decision points and potential centers of gravity, this paper aims to provide a foundational application of A.I. that can prepare commanders for complex, non-linear Operational Environments (OEs) and provide easier springboards for branching COAs and contingency plans. The transparency of this model will hopefully enhance humans’ trust in its accuracy and decision-making, which is central to adoption and symbiosis between the human planner and the A.I. Additionally, it helps provide linear contextualization and narrative for what might be very non-linear rationale, making it more explainable and understandable to humans (Cerri et al., 2018).

Possible Solutions to be Explored

Modern A.I. models are capable of processing information that is challenging for humans to draw conclusions from. Unlike the human mind, A.I. finds strength in processing more and complex information as the algorithmic techniques were developed to help optimize outcomes by reducing errors. For example, in the sports industry, an A.I. using data-mining techniques can learn from the results of past games by examining individual player and team performance. As we will explain later in this paper, such an A.I. system can aid managers with the line-up against a particular opponent, in effect helping optimize roster management with the goal of increasing the probability of winning. As A.I. becomes less of a black box of decision making, it can be similarly leveraged as a tool to assist military decision makers in understanding the strengths and weaknesses of their forces in any given context.

Although modern A.I. models are capable of processing large varieties of data, it is important to properly train the A.I. model. To train A.I. models, appropriate training data must either be synthesized through simulations and experiments or extracted from past examples. Real world, past examples are challenging and relatively unfruitful for multiple reasons. For example, as militaries evolve, the systems, contexts, and missions in warfare change and can become obsolete for training an A.I. to identify the strengths of novel systems. Within the digital world it is possible to generate enough training data through performing many traditional, tabletop, wargaming scenarios. However, it may be advantageous to remove human decision making from the wargaming scenarios. A.I. agents may be capable of speeding up the cycle time without a significant cost to the quality of data. This paper will explore the use of digital environments in wargaming which could be leveraged to generate useful training data.

LITERATURE REVIEW

Theories, Constructs, and Concepts

A deep dive into theories surrounding force composition development and force laydowns elucidates the complexity of decisions associated with these topics. Unfortunately, there exists a gap between the complexity of these decisions and the complexity and adaptability of systems used to support decision makers (Murphy, 2014). The complexity present in such decision making has led innovators to explore using A.I. models for decades. For example, Sumari demonstrates modern successes supporting warfighters using A.I. in command and control (Sumari et al., 2021). However, the focus of A.I. efforts has been on developing warfighting strategies and mission planning. While Zhao demonstrated the application of A.I. to force dispersal scenarios, the ability to evaluate the expected strength of a given end state or laydown is solely evaluated by a simple wargame simulation (Zhao and MacKinnon, 2023).

The prevailing research on digital environments for wargaming provides promising literature to support deriving data from wargames to train an A.I. system. The basic elements of a wargame are the players, the scenario, a rule set, and an adjudication method (Wade, 2018). A digital environment intended to support wargaming must consider those four elements to be successful. For the purpose of developing data to train an A.I. system to assess the effectiveness of different force laydowns and their compositions, a digital environment must further enable players to be replaced by an A.I. agent that can perform in a variety of scenarios. The framework of such a system could consist of a model library, a database, a simulation engine, an analysis and evaluation system, and data distribution system (Deng et al., 2016). Alternatively, a framework could consist of the combat decisions of each player, a battlefield situation display, files describing the scenario, a data distribution platform, a wargaming simulation engine, local output records of the wargame, and a support library (Huang et al., 2021). In this example, the player combat decisions would come from an A.I. developed to play wargames. Many such systems have been proposed and tested such as a Multi-Agent Deep Deterministic Policy Gradient based method (Yu et al., 2023). With this groundwork, we explore the opportunity to expand the reach of A.I. systems in the defense industry.

METHOD

Research Questions Examined

Can new A.I. systems used in professional sports be applied to force laydowns and the analysis of force composition?

Can we create a digital environment to capture wargaming data from which to train an A.I. model?

Research Method

To understand the current state of wargaming in the United States as well as the applications of A.I. proposed or in action in the Department of Defense, we performed a literature review spanning industry proposals to Department of Defense whitepapers. As revealed by our literature review and in accordance with our experience, A.I. in the defense industry has clear gaps in its application. However, A.I. techniques are highly flexible across industries. Exploring the results of A.I. decision making support in relatable scenarios will demonstrate the opportunity to exploit similar A.I. systems when optimizing force compositions and laydowns.

To see how A.I. could potentially aid in force laydowns, we look to how A.I. is being used to aid decision-making in games and professional sports. We look to examples of how, by understanding an A.I.'s thinking behind why a team will win or lose against a specific opponent, professional sports use data with new A.I. techniques to analyze their opposition. The A.I. tool thus helps the management of a team to optimize decisions and increase the probability of victory.

We also look to professional sports to examine how they have created a digital environment that can be used by A.I. to help win games. In recent decades, managers of sports teams have significantly increased their collection and use of data for decision-making. We will discuss what types of data is required and key digital architectures to deploy an A.I. system designed to help win games.

We chose to look at work done in the sports industry using A.I. as optimizing decision making to win in professional sports has surprising parallels to a military conflict (two teams with differing roster strengths vs countries with differing force strengths, choice of how to build roster before match vs force before conflict, player positioning vs force positioning, sequential decision making, goal of winning, etc.).

RESULTS AND DISCUSSION

For some time, A.I. has been used to dominate human opponents in games where decisions made either result in victory or defeat. In 1997, IBM created DeepBlue as a demonstration that even the decision making of the world's top chess grandmaster could not compete with the decision optimization of an A.I. in a game (Campbell, 2002). In 2016, Google's DeepMind's AlphaGo was a demonstration of how new techniques in A.I. could be used to rapidly discover new winning strategies in Go, a game played for 2,500 years, by 20 million people today and whose grandmasters study classic games from one thousand years ago (Silver, 2016). A.I. has also deployed novel strategies in e-sports, to defeat top-ranked human teams in cooperative battle play (Berner, 2019).

The power of an A.I. to find novel winning strategies in games has now altered how professionals prepare so as to increase their chances of victory in a match. For example, Magnus Carlsen, the world's top chess grandmaster, recently said that neural networks have become so powerful that if he faced an underdog opponent who has trained by learning the moves a neural network would make in certain situations, that opponent could defeat him. So Magnus now trains with a neural network to learn new strategies to winning as well (Fridman, 2022). One reason why humans are limited in their capacity to see dominant winning strategies, compared to an A.I. is that our minds have cognitive biases. For example, Carlsen says he can see if an opponent is deploying A.I. strategies to win when they sacrifice a powerful chess piece early on (Fridman, 2022). Why? Because the human mind has a bias when it comes to loss-aversion and would be less likely to see the dominant strategy to win the match (Tversky, 1991; Fridman, 2022). A natural question comes to mind: could Commanders use A.I. to help optimize a force laydown that increases the chances of winning? Just like a lower ranked chess player could beat the world's top chess player with the help of an A.I. tool, it seems that a less powerful nation could overtake a more powerful nation on the battlefield if decisions are better optimized.

Why does a human mind fall short against an A.I. when trying to win a game? One explanation is that humans are limited by the computational capacity of the brain, which has taken millions of years to evolve. In comparison, modern A.I. systems are not limited by biology and evolution and their ability to scale and grow in computational capacity is overtaking tasks that have traditionally relied on human decision-making (Solé, 2022). We look to the sports industry for how teams use historic data from past games and A.I. to optimize decisions in building and managing its team to defeat an opponent.

Compared to the days of the newspaper box score, sports teams can be seen as drowning in data, which is a problem given the human mind is constrained by biology in its processing of information. Teams, as a result, are now using A.I. systems to process this information and, using data mining with machine learning, to highlight the top insights in the data that matter (Beal, 2019; Li, 2021). How does this relate to force composition and laydowns? One can think of sports statistics as describing the strengths and weaknesses of different tools available during a conflict with an opponent. For example, in baseball each player has different data points about success rates, just like weapons systems have expected probability to hit. Baseball players also can be placed in different locations and have different ranges, with data on that leading to optimization of player placement, just like weapons systems can be placed in different areas of the battlefield and have certain ranges. Athletes on a roster have statistics that measure their defensive success vs offensive success, as weapons systems can be more defensive or offensive in nature. As such, the general manager who uses A.I. to optimize roster decisions and the make-up of a team, can be seen as similar to a Commander who uses A.I. to help optimize force laydowns.

Why do managers of sports teams use A.I. when making decisions on roster management? Because A.I. systems can help increase the chances of victory (Beal, 2019; Li, 2021). How does this work? By data mining the results of past matches (battles), A.I. is able to understand and quantify which factors in a team's roster and strategy are strengths and weaknesses when playing against a specific team (Bunker, 2019). In order to better understand how this would work, let's present an example from the recent MIT Sloan Sports Analytics Conference of how A.I. (AlphaPlay) can break down an upcoming match (below) (Hall, 2023). To protect the confidentiality of professional sports teams, publicly available information will be used to visually demonstrate insights produced by A.I. systems to increase a team's chances of victory.

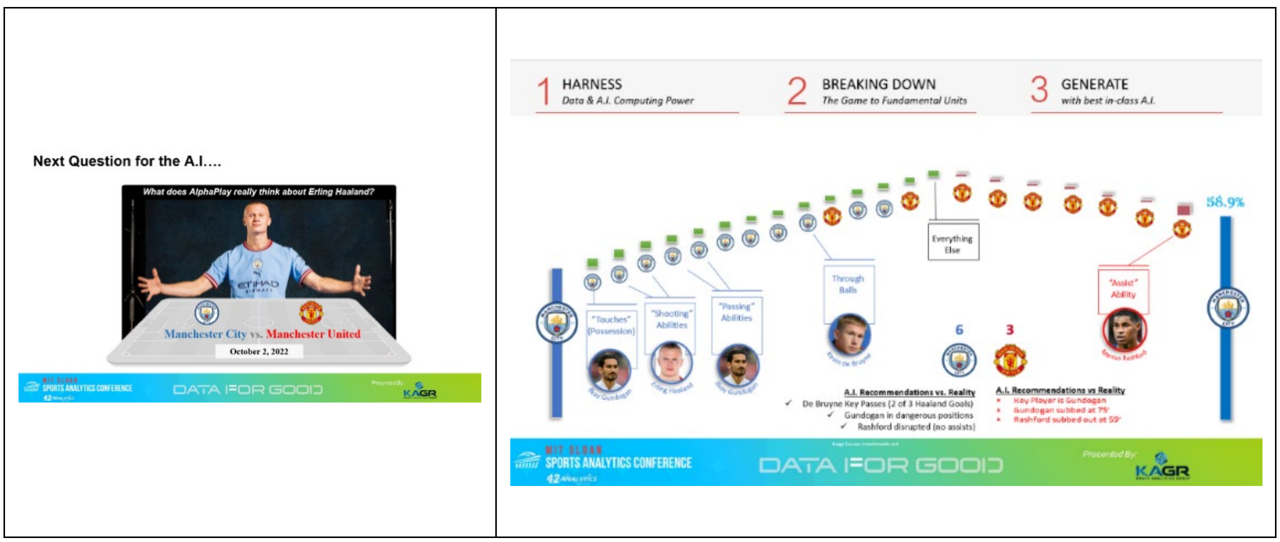

Figure 1. Sample A.I. Output to Aid Sports Teams

In the figure above, you will see that the A.I. starts with the baseline win percentage for a home team and uses large amounts data from past soccer matches and its players for the A.I. to learn what contributes to wins or losses of a team (Hall, 2023). From there, the A.I. is asked to predict the outcome of an upcoming match, here the A.I. estimates Manchester City has a 58.9% chance of winning, by analyzing the specific strengths and weaknesses of each team's players/strategies. The players who are contributing to Man City's chances are those that produce a green bar, while players that decrease Man City's chances of winning produce a red bar. There are 600 different features about the match that the A.I. analyzes and only the top features impacting the win are displayed. The cumulative impact of the other features not individually displayed is grouped together where it says, "Everything Else".

What are the practical implications for a professional sports team using this A.I. system in advance of a game that they are preparing to win? It allows managers of a professional team to quantify what the top strengths/weaknesses are in their roster when comparing it to the roster of an opponent (Hall, 2023). For each opponent, the A.I. detects different strengths and weaknesses. This helps a manager understand nuances that otherwise aren't detectible or quantifiable by the human mind (Hall, 2023). In the above example, the player Erling Haaland is a superstar goal scorer for Man City, which is easy for a human mind to detect. The A.I., however, sees that the third-string midfielder, Gundogan, is the strength to leverage in playmaking against Man United, a critical distinction to the odds of winning, a math that a human does not detect. Additionally, Man United's greatest strength against Man City is the assist ability of the striker Rashford, another nuance a human mind could not detect. As a result of these and other nuances, Man City can increase its probability of winning the match by using Gundogan as the primary playmaker and by focusing on pressuring Rashford. This highlights the human tendency to focus on "scoring" when the difference maker in this match is actually emphasizing and suppressing specific players' playmaking and assist abilities, similar to the shift in focusing on weapon effects to the networks and capabilities that enable them (communications, track management, etc.). A.I. today, however, is able to make judgements about the platforms and weapons (players) a team has to help that team win a conflict (match).

When optimizing a force structure and its deployment, a Commander should use all the available relevant information, often called data-driven decision making (Zhang, 2022). Each part of the force should be analyzed for strengths, weaknesses, which impact, among other things, the quantity that should be made available, its positioning and its sequencing (Evensen, 2022). One method for doing this is to quantify the strengths and weaknesses using statistics about each component of the force, like how players on professional sports teams have their offensive, defensive, and other athletic abilities quantified in statistics. For example, weapons systems may have statistics on their accuracy, lethality, range, speed, survivability, quantity, detectability, positioning, etc. If statistics about strengths and weaknesses of a Commander's force and the opposing force are taken into account as well as information related to each force's successes and failures from past wargames, an A.I. is able to quantify the strengths and weaknesses of a Commander's force and the opposing force, similar to a sports team training an A.I. on its player statistics, box score and play-by-play information to detect strengths and weaknesses of the team before an upcoming match against an opposing team (Hall, 2023). Acting on such information can increase the chances of winning a conflict. Let's look at an example below of how this could look to a Commander.[1]

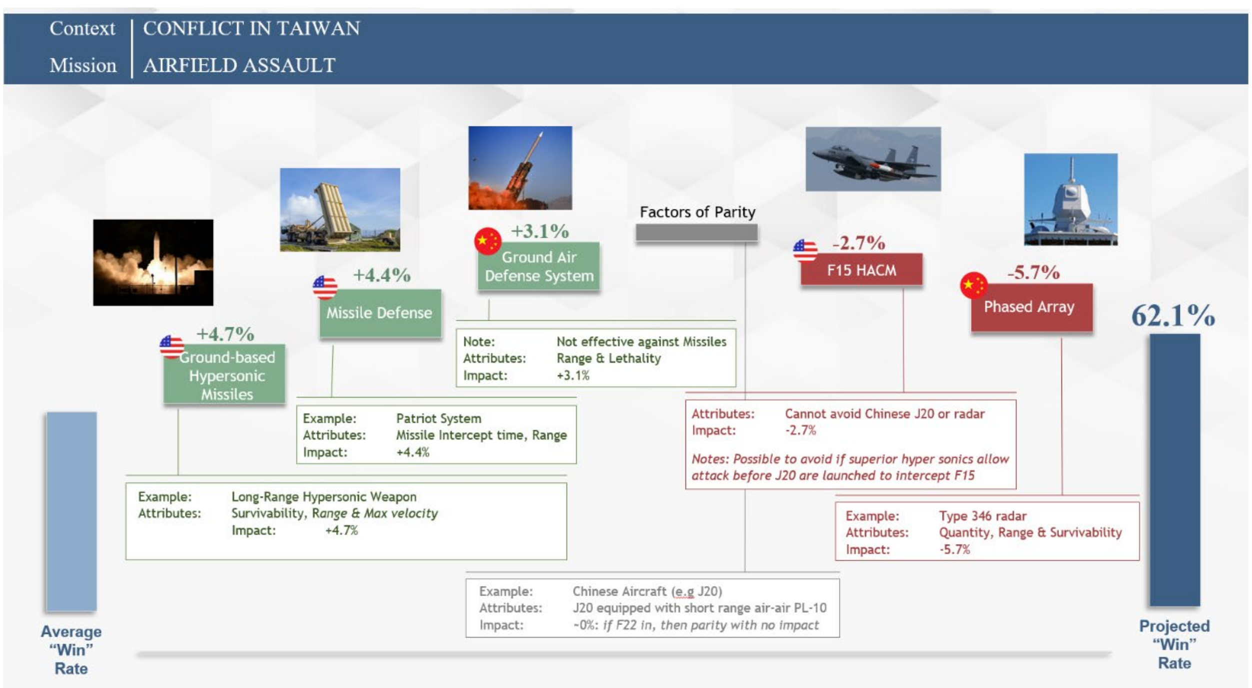

Figure 2. Sample A.I. Output to Aid Commanders

In advance of a conflict, a Commander can consult the A.I. for insights into the strengths and weaknesses of a particular force laydown. For example, the placement or insufficient quantity of a weapons system may be seen as a weakness. Just like in a sports team, it may lead to discovering nuances about a force that the human mind previously was not able to quantify and that can be exploited for increased chances of victory. For the first time, a Commander would be

[1] To maintain confidentiality, this example is hypothetical and not drawn from actual past war games.

able to use A.I. to understand and prioritize which strengths to exploit against an opponent and weaknesses to be wary of (sub-optimal quantities, sub-optimal locations, etc.). This is similar to how professional teams can understand strengths and weaknesses to adjust strategies and tactics before each match, with the A.I.'s findings bespoke to each opposing line-up (Hall, 2023). Just like a manager of a sports team can be guided by A.I. to make roster changes in the off season to defeat its strongest opponent, a Commander would be able to make changes to its force structure after studying the A.I.'s analysis of the two forces in a potential conflict. A.I. can also calculate the impact of allies joining the battle on increasing chances of victory, essentially being a force multiplier for the force composition. As a result, not only could such an A.I. system ease a Commander's path to victory, like an A.I. providing insights for a chess grandmaster to a more efficient win or a coach exploiting otherwise unappreciated roster mismatches to defeat an opponent in a match, but it could impact international diplomacy by seeing that without certain allies the chances of victory are significantly reduced (and the resulting causalities and other costs go up significantly).

Training such an A.I. system requires large amounts of data that this paper proposes synthesizing using a digital wargaming environment. There are many commercial off the shelf solutions that can support the frameworks described in literature. For example, scenarios and mission threads can be built with SysML model-based systems engineering (MBSE) software. An MBSE approach ensures scalable and flexible scenarios can be constructed and easily accessed by a variety of simulation engines, A.I. agents, and other software that could comprise the digital wargaming environment (Mittal and Gillespie, 2022). While the simulation could be run within a SysML based MBSE model, other modeling and simulation engines allow users to develop a simulation that can more easily apply an A.I. through agent-based modeling while discrete event or system dynamics models handle non-decision-based updates to the simulation. An event driven or agent based simulation can interact with multiple databases and repositories that would hold parameters about simulation entities and adjudication rules. This database can be constructed in the SysML model to unite the information from multiple current military databases and repositories. The framework for one such digital environment is pictured below in Figure 3.

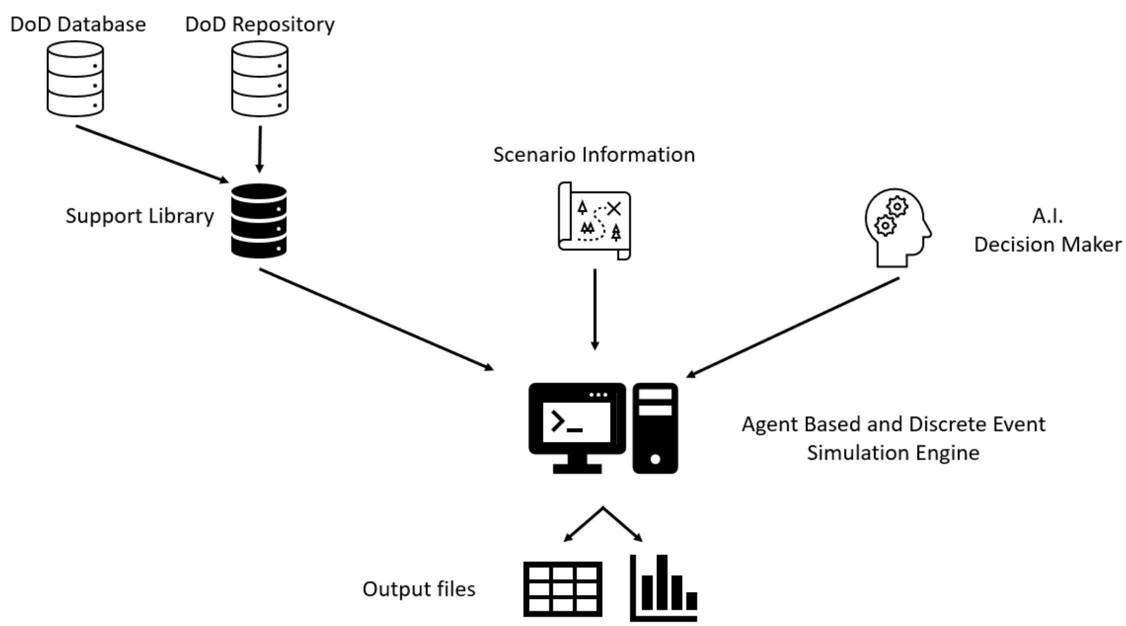

Figure 3. Sample Digital Engineering Framework for Wargaming

This paper demonstrates that optimizing decision making to win in professional sports has surprising parallels to winning a military conflict (i.e., two teams with differing roster strengths vs countries with differing force strengths, choice of how to build roster before match vs force before conflict, player positioning vs force positioning, sequential decision making, goal of winning, etc.). With these A.I. systems, a Commander can learn lessons from past games to better understand their force, its strengths and weaknesses, and gather insights to increase chances of success against an opponent. This A.I. technology already exists (does not need to be developed) and can be implemented to aid a nation in prevailing in a conflict if information from war games is maintained in a manner that is optimized for A.I. systems.

Relevance of Findings in Light of Previous Studies

As a result, this paper finds that the approaches used in professional sports to create an A.I. system to aid in decision-making, can aid military decision making, such as force design and laydowns, using war games and lessons learned by teams in professional sports. The importance of such a finding is that it is now very possible for a country to deploy A.I. systems to increase chances of winning in a conflict, whether the dominant side or the underdog. However, by understanding the success of A.I. in data rich fields such as sports, we see a great opportunity to leverage sports A.I. techniques in a data rich environment that would be provided by a digital environment for wargaming.

Research Limitations

Currently, information from conflicts is not kept in a manner that is optimized for A.I. systems. If it is standardized – think a box score in sports – A.I. systems could be used to optimize decision making in conflicts. By collecting the information from these past war games in an organized manner, similar to how sports leagues and the media have organized their record keeping of past matches, the A.I. system can be created to analyze these conflicts and provide advice on future conflicts.

It is important to consider the implications of classifying modern technologies. National security is paramount, but defense specialists should not hesitate to explore the collaboration opportunities with seemingly unrelated fields of work. Future researchers could propose standardization of data from war games and the effectiveness of pieces of the force laydown to optimize for A.I. decision-recommendations, looking to inspiration of how sports box scores and athlete performance is kept for analysis by A.I. systems. Additionally, the implementation of large language models (LLMs) to more seamlessly interact with A.I. insights that are provided real-time and speed up decision making in warfare.

CONCLUSION AND RECOMMENDATION

Optimizing force composition and laydowns are tasks that face increasing levels of complexity. As the systems of systems used in combat by both allies and adversaries become more complex, determining their individual contributions to the overall success or failure of any given mission could become insurmountable for a human mind. Furthermore, these decisions can be useless unless enacted rapidly. Adaptability and flexibility are key to success in warfare. As such, this paper explored whether innovative A.I. systems can be applied to force laydowns and the development of force capabilities given the current state of digital engineering and wargaming.

This paper found that A.I. systems being used by professional sports teams to increase their chances of victory can be adapted and deployed for a Commander. By deploying A.I. systems similar to those used in professional sports, Commanders can learn lessons from past games to better understand their force, its strengths and weaknesses, and gather insights to increase chances of success against an opponent when determining force design and laydowns. Application of this technology is potentially disruptive and can propel the underdog side to victory, as it has in sports.

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