

Optimizing Demand Forecasting in Supply Chain Management With Artificial Intelligence
(Technical Report)

An Examination of Artificial Intelligence in Modern Warfare and Conflict Resolution
(STS Research Paper)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

The rapid advancement of artificial intelligence (AI) technology has transformed industries worldwide, fundamentally altering niches from corporate operations to government policies. By offering unprecedented enhancements in system efficiency, decision-making, and data-driven insights, this wave of AI development presents remarkable opportunities to drive and reshape innovation. Yet, alongside these benefits, the ethical and societal implications of AI are becoming increasingly critical to address. As AI systems become more integral in decision-making, they raise issues around autonomy, accountability, and control, given the multitude of risks associated with over-reliance on autonomous processes. Accordingly, my research aims to explore both the multifaceted practical and ethical dimensions of AI by examining its application in two distinct areas: supply chain management and modern warfare.

My technical report investigates the integration of AI into demand forecasting workflows, rooted in my hands-on experience as a Data Science intern at o9 Solutions during the summer of 2023. Throughout my internship, I focused on analyzing historical product sales data to refine various demand forecasting models and produce subsequent insights that would support more accurate and actionable recommendations for clients. In my perspective, this experience underscored AI's capacity to deliver practical value in supply chain management (and the corporate sector, in general), where precision and efficiency are vital; by enhancing demand forecasting accuracy, as in this instance, AI technology can help automate the correction of data anomalies, optimize resource allocation, and enable improved, agile responses to market demands. These improvements underscore the potential of AI-driven solutions to transform operations in manners that efficiently benefit businesses and consumers.

Meanwhile, my STS research paper explores a different dimension of AI: its integration into military operations and its implications for modern warfare. As it stands, AI has already begun to reshape the military landscape, influencing everything from strategic decision-making to combat tactics to international relations. This analysis focuses on the ethical, societal, and technical dimensions of AI-driven warfare, specifically analyzing historical case studies and existing governance frameworks to understand how a cultivated emphasis on technological superiority often overshadows diplomatic efforts for peaceful conflict resolution and shifts military decision-making from human-centered approaches to technology-driven solutions. The stakes of AI in warfare are immense, and the ethical questions it raises go beyond mere technical considerations; we, as a society, are forced to now consider fundamental aspects of human oversight, responsibility, and the role of technology in preserving peace.

While my technical report and STS research paper address distinct applications of AI, they are unified by a common theme—understanding the transformative impact of AI on human decision-making and emphasizing the need for responsible innovation. In the context of supply chain management, AI offers clear benefits in improving efficiency, reducing costs, and enhancing responsiveness. AI in warfare, however, raises greater ethical questions about human oversight and the potential for unintended consequences. This dual exploration, then, underscores the importance of balancing technological advancement with ethical considerations, illustrating how AI can both empower and challenge humanity.

Technical Report

In supply chain management, the use of AI has revolutionized how businesses approach demand forecasting given the prospects it offers of more accurate predictions and efficient

resource allocation. During my data science internship at o9 Solutions—a Texas-based integrated business planning company—in the summer of 2023, I worked directly to this end. As an intern, I joined a team focused on refining demand forecasting models within the company’s proprietary demand projection software, with my work centered on tackling two primary challenges: the detection of recurring demand patterns not linked to traditional drivers, and the mitigation of random anomalies in the historical product sales data.

The first task I worked on addressed the issue of recurring anomalies in historical sales data, which were unexpected spikes and drops in demand that were not linked to predictable driver events (such as holidays or promotions). If left undetected, these unexplained patterns could cause the forecasting models to miss reflecting recurring events, leading to inaccurate projections. In employing AI-powered time series classification algorithms, I devised a solution to detect these recurring patterns and identify potential demand drivers previously unrecognized by the system. From there, I associated these patterns with likely causes to enable the forecasting models to better capture their impact, ultimately improving overall forecasting accuracy.

My second task centered on managing isolated spikes and dips in the historical product sales data that did not follow repeatable or identifiable patterns. These particular data anomalies posed a different problem than the first task; without corrective action, they could lead to skewed future forecasts by being misinterpreted as trends, when, in reality, they may only be present as a one-time occurrence. To address this, I configured AI-supported anomaly detection algorithms that passed detected anomalies through a history outlier correction module, which used an in-built outlier cleansing system to enable the forecasting models to disregard these irregularities, thereby preserving the integrity of future predictions.

Beyond these tasks, I also had the opportunity to apply various AI-based forecasting models to create customized demand insights for different clients. Depending on the client's needs, I used models including ARIMA (Autoregressive Integrated Moving Average) and SARIMA (Seasonal ARIMA), which take into account the full breadth of previous known values—and seasonal trends, if applicable—to predict future time series values, along with simpler Naive and SNaive (Seasonal Naive) forecasting models, which rely exclusively on the last known value—and seasonal trends, if applicable—to predict future time series values. Upon selecting the most suitable model for each client, I observed how tailored forecasting solutions can directly impact different business case outcomes.

Reflecting on my time at o9 Solutions, this experience illustrates how AI can transform demand forecasting by making it more accurate and adaptable, allowing businesses to enhance the efficiency of their response to changes in consumer demand. Furthermore, this work demonstrates how AI can be used to overcome traditional forecasting limitations, address complex problems in supply chain management, and provide practical solutions that have tangible benefits for various clients.

STS Research Paper

In parallel to AI within the corporate sector, the integration of AI into modern warfare has greatly transformed the conduct of conflicts and the development of military strategies, as AI technologies continue to reshape the battlefield. The primary focus of my STS research paper is to explore the ethical, societal, and technical implications of AI in military contexts, assessing how AI is shaping the future of warfare, international relations, and conflict resolution,

particularly in regard to the general global security environment with the emergence of new trends, threats, and ethical challenges (Masakowski, 2020).

The central research question guiding this study is: how has the integration of AI into military operations influenced conflict resolution and the human cost of war? This question is significant because AI-driven systems can alter the ethical landscape by reducing human oversight in life-and-death decisions, which reaffirms serious concerns around accountability and escalation risks. Not to mention, the absence of comprehensive, robust global standards governing AI in military contexts due to the numerous complexities associated with establishing this governance heightens the possibility that these technologies could undermine current laws, patterns, and trends and destabilize international peace (Garcia, 2023). As such, these considerations necessitate responsible human control and accountability in military decisions, such that military and civilians alike can continue to trust the systems that guide and protect them (Schraagen, 2024).

Beyond just foundational systems, AI is becoming increasingly intertwined throughout military structures and tasks, including command and control, information management, logistics, and training, which has vastly broadened the scope of potential warfare actors and consequences (Grand-Clement, 2023). For starters, new technologies in smartphones and social media have prompted participative warfare among civilians through digital means, blurring the lines between combatants and non-combatants (Norman, 2024). Likewise, in the nuclear enterprise, AI technology has displayed the potential to influence strategy and escalation risks by automating key decisions, which may increase the likelihood of nuclear conflict—accidental or intentional—as its limitations in nuanced judgment could lead to misinterpretation or

overreaction, consequently catalyzing significant theoretical and policy ramifications (Johnson, 2023).

Undoubtedly, AI applications in the military can revolutionize existing operations, but they can equally introduce new, unprecedented ethical and security challenges. Namely, AI-enabled operations continue to raise global concerns over data privacy, cybersecurity, and the manipulation of civilian perceptions, largely due to the recent surge of psychological warfare and the subsequent rise of disinformation (Hageback & Hedblom, 2021). Thus, as militaries grow increasingly reliant on AI, it becomes more apparent that the potential shift from diplomatic to technology-focused strategies may not just affect the methods and strategies of conflicts themselves, but may extend conflict resolution efforts and the duration of conflicts as well. This evolving landscape underscores the importance of addressing strategic, ethical, and operational impacts from a comprehensive analytical perspective, especially considering the possible emergence of innate bias and sentience in future war machines (Roy, 2024).

To investigate these issues, this research will employ qualitative and quantitative methods, primarily centered on historical case studies and analysis. By examining the role of “intelligent” AI warfare in past and present operations—such as the ongoing Palestinian-Israeli conflict—this research aims to explore AI’s extending tactical uses in warfare, and the pertinent scientific and technological trends that have given rise to these deployments (Wu, 2022).

Additionally, military innovations in information technology and communication networks relying on AI will be reviewed to understand their influence on conflict dynamics, particularly in the sensing, reasoning, and learning advantages they offer (Jensen et al., 2022). This research will also evaluate AI and its applications in other domains (including naval and aerial warfare) to highlight the unique operational advantages it offers and ethical concerns it presents particular to

these domains (Tangredi & Galdorisi, 2021). Ultimately, the evidence collected will be synthesized to address the benefits and risks of using AI in military contexts and outline the perpetual need for international regulations and governance to prioritize responsible use, prevent unintended escalations, and maintain humanitarian standards in warfare.

Conclusion

It cannot be denied that AI has immense potential to drive meaningful advancements across both commercial and military domains; nonetheless, it also presents profound operational and ethical challenges that require responsible oversight. Understanding this, my technical report focuses on the optimization of demand forecasting in supply chain management using AI, defining how AI can enhance business operations by improving forecasting accuracy, while my STS research paper examines the implications of AI in modern warfare and conflict resolution, highlighting the societal complexities and impacts of AI deployment in military contexts. Together, these projects will help cohesively emphasize the dual nature of AI in its potential to drive progress and its need for responsible innovation to address dangers, and ensure that these technological advancements truly benefit society as intended.

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