Issue Brief

Beyond Targeting

The Untapped Role of AI in Military Decision-Making

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Executive Summary

> *Humans will always make final decisions on what to shoot and what not to shoot and when to shoot. But advanced AI tools can turn processes that used to take hours and sometimes even days into seconds.*
>
> *– Admiral Brad Cooper, on X (formerly Twitter), March 11, 2026*[1]

Several years ago, the U.S. Army's XVIII Airborne Corps demonstrated the power of Maven Smart System (MSS) to accelerate targeting processes, accomplishing with a 20-person team what in 2003 had required a team of 2,000.[2] Since then, the U.S. military has embraced AI-enabled decision support systems (AI-DSS) such as MSS at Combatant Command headquarters around the globe. Media reports indicate that MSS is a key enabler of the sustained high-tempo targeting process displayed in Operation Epic Fury.[3]

The military applications of AI-DSS—software systems that use a variety of AI tools to ingest, generate, share, and act upon information—can help with much more than just targeting processes. Nearly any problem that deals with large volumes of disparate kinds of data as part of a decision process that requires interpreting that data, assessing the situation, making decisions, and implementing those decisions (and often repeats those steps in a regular cycle) can benefit from AI-DSS tools.

Public discussions of AI-DSS have relied on mostly vague notions of how these systems might be applied in military processes. We address this gap here with two case studies of operational-level military processes where the application of an appropriate AI-DSS tool could bring improvements on par with what XVIII Airborne Corps achieved for the fires process. One case study examines applying AI-DSS to the resupply of ammunition to Army fires units; the other focuses on applying AI-DSS to the processes that drive the Joint Air Tasking Cycle (JATC). In both cases, AI-DSS could enable these processes to be performed faster, more flexibly, and with less manpower while maintaining quality and human judgement. In the case of the JATC, AI-DSS offers the opportunity to revisit the decades-old 72-hour timeline for deliberate planning of daily air sorties. Both potential applications come with new risks that must be addressed, even as old risks are retired.

These case studies reveal that the primary obstacle to implementing suitable AI-DSS capabilities in these cases is not software development, but **rather accessing the data needed by such tools**. Much of the required data is only available at individual units, often in unstructured formats such as PowerPoint slides or unit-unique spreadsheets. Overcoming the bureaucratic hurdles to make such data digitally available to AI-DSS needs to be the first priority in any scaling plan.

Recommendations from these case studies are:

1. **Make needed data digitally available to AI-DSS.** The top-level departmental support for efforts to break through any bureaucratic or cultural barriers has never been stronger—now is the time to act. The Chief Digital and Artificial Intelligence Office (CDAO) has been given authority and tasking on this issue by Secretary Hegseth's artificial intelligence memorandum of January 9, 2026.[4]

2. **Examine the best practices that the XVIII Airborne Corps and others are using—including their DevSecOps-style development approach combining operators and software engineers and—adopt/adapt them.** There is no need to reinvent this wheel. CDAO should collect and promulgate these lessons. CDAO should also resource data and evaluation support teams at the Combatant Commands to augment their AI-DSS development and deployment efforts at the edge. These teams should be staffed with personnel who have the necessary expertise and/or experience to bring to bear the lessons learned and best practices acquired across industry, academia, and the joint force.

3. **Deploy these capabilities to command centers during real-world operations** to develop warfighting best practices, accelerate the growth of a community of experienced users, and provide operational feedback to software engineers.

As the case studies presented here suggest, these steps would improve some of our most important Army and joint fires-related processes and could responsibly accelerate the development and adoption of AI-enabled capabilities across the U.S. military.

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Overview and Introduction

When the XVIII Airborne Corps deployed Maven Smart System (MSS), an AI-enabled decision support system, it marked an inflection point for the U.S. military: 20 warfighters in 2022 accomplished targeting work that had required 2,000 personnel during Operation Iraqi Freedom in 2003.[5] Since then, the military leadership has made clear that it intends to accelerate adoption of AI-DSS tools, and the actual employment of MSS across the force has expanded dramatically. News stories[6] and CENTCOM's own public statements[7] suggest the high-tempo targeting observed in Operation Epic Fury was made possible with the help of AI tools.

What exactly is an AI-DSS? A fuller explanation is provided later in this paper, but a simple answer is that an AI-DSS is a software system incorporating a variety of AI tools that support warfighter decision-making by performing six key functions:

- **Ingest** data of all kinds and organize it into a knowledge base.
- **Generate** insights and information tailored to support individual users.
- **Enable** users to easily create outputs tailored to their needs.
- **Automate** certain steps required to implement and execute a decision.
- **Share** a knowledge base with others to enable a common understanding.
- **Interface** directly with existing systems, eliminating re-entry of information.

AI-DSS has proven its value in the XVIII Airborne's targeting processes, but "20 do the work of 2,000" improvements are available in other operational processes too. We present two illustrative case studies of operational-level military tasks where the development and deployment of tailored AI-DSS tools could yield significant process improvements:

- **Applying AI-DSS tools to support the resupply of ammunition to Army fires units.** What the XVIII Airborne Corps has done to make Army artillery fires processes more rapid and responsive is a game changer. But it also means artillery units will run out of ammunition quickly unless we also streamline the resupply process. A huge amount of information and coordination is required to develop and execute an ammunition resupply plan, presenting an opportunity for AI-DSS tools to deliver significant operational planning efficiencies.

- **Applying AI-DSS tools to the Joint Air Tasking Cycle.** The Joint Air Tasking Cycle (JATC), focused on delivery of weapons by aircraft, is significantly more complex than the Army Targeting Cycle, which is focused on artillery and missile fires. The JATC requires 72 hours of lead time to plan and coordinate the aircraft and aircrews. There is opportunity for AI-DSS tools to achieve manpower efficiencies and greatly shorten the air tasking cycle to make airpower more responsive to emergent operational needs.

These case studies show that AI-DSS offer significant potential improvements. The most significant challenge in both cases is not software development, but rather gaining access to data that today is often locked in non-standardized documents (such as spreadsheets) held by individual small units. We conclude with suggested next steps for responsible development and deployment of AI-DSS tools for the two example operational problems.

What follows establishes the overarching case for military AI-DSS by explaining what an AI-DSS is, what kinds of problems it can address beyond targeting, and why the full power of AI-DSS will be realized only when these systems are deployed at scale across a spectrum of operational problems. While we focus here on operational tasks, we will address other potential AI-DSS applications for up-echelon or coalition decision-making in separate forthcoming papers.

The Drive for Military AI-Enabled Decision Support Systems (AI-DSS)

Military Need

Military leaders are required to make high-risk decisions with sweeping national security implications under conditions of uncertainty. The mistakes commanders have made range from the highest level—such as Bonaparte's invasion of Russia and Churchill's Gallipoli disaster—to the tactical—such as the mistaken NATO bombing of the Chinese embassy in Belgrade (1999) or the U.S. airstrike on the Kunduz Hospital in Afghanistan (2015). Over centuries, militaries have developed complex, robust processes to try to manage battlefield decisions, seize tactical and strategic advantage, maintain complex logistics, and strike the highest priority targets. The results, especially for the United States military, are impressive but hard won, and despite large staffs and rigorous processes, mistakes and missed opportunities persist.

In searching for new opportunities to address the challenges of military operations and decision-making, it should be little wonder that the U.S. and other nations are turning to AI decision support systems (AI-DSS). While the U.S. and other militaries have a long history with earlier forms of artificial intelligence,[*] the scale and scope of the current interest in AI is unprecedented.

The promise of AI is that it can recognize patterns and anomalies in data that might otherwise be missed by humans. Moreover, unlike human commanders, AI can process more information more quickly without requiring sleep or succumbing to human stressors. When paired with modern data management and software, the presumption is that by using AI, militaries are poised to both accelerate and improve what Air Force Colonel John Boyd famously termed the OODA loop: the ability to "observe, orient, decide, and act" on a battlefield.

Advances in AI techniques over the past decade make this promise seem more realistic. With so much new potential, leaders are challenged now to choose where to devote time and resources for change, and determine which AI applications might yield the

[*] In the 1980s the U.S. military deployed air defense systems such as Patriot and Aegis, which incorporated expert systems that enabled them (when so activated by operators) to engage incoming enemy missiles and aircraft automatically. Also, early (pre-GPS) versions of Tomahawk missiles navigated autonomously to their targets using algorithms that matched terrain maps stored in its computer to the terrain patterns "observed" by the missile as it flew.

largest benefits. This paper examines two case studies where “20 do the work of 2,000”–level improvements are possible.

Evidence of AI-DSS Adoption

Military AI-DSS are still new, but case studies of adoption are beginning to emerge. Internationally, journalists and researchers have detailed Ukraine’s adoption of the Delta system, Israel’s adoption of the Gospel and Lavender systems, and China’s experimentation with strategic and tactical AI-DSS.[8] While each system has substantial differences, at their core these examples leverage data, software, and AI to gather, parse, and use intelligence from a broad variety of sources to support military (usually targeting) decisions.

For the U.S. military, the most well-known example of AI-DSS adoption is Maven Smart System (MSS), which has spread throughout the operating forces at an unprecedented pace. In August 2020, the XVIII Airborne Corps launched its first experiment with MSS, a test Colonel Joe O’Callaghan described as showing “the art of the possible”—the test itself did not go especially well.[9] By 2022, however, it had transformed to become a central part of the XVIII Airborne Corps’ targeting processes. By 2024, the Johns Hopkins Applied Physics Laboratory and CSET working in partnership analyzed MSS, showcasing its ability to enable the XVIII Airborne Corps in a way that reduced the personnel necessary to conduct the targeting cycle to 20 from 2,000.[10] By 2025, Vice Admiral Frank Whitworth, director of the National Geospatial-Intelligence Agency (NGA), declared that Maven had achieved 20,000 active users.[11] By early 2026, every combatant command had MSS licenses.

Scaling AI-DSS

The Administration’s AI Action Plan,[12] Secretary Hegseth’s pronouncements both during confirmation[13] and during his September 2025 meeting with senior generals,[14] and other formal guidance[15] and public statements[16] make clear the Pentagon’s goal to rapidly and effectively adopt AI to maintain and grow the U.S.’s warfighting advantage. These statements make clear that success is not one operational system in one unit, such as the use of MSS by XVIII Airborne Corps, but rather the expansion of AI-DSS to serve both *more users* and address *more military needs*. Based on these declarations and evidence from MSS, AI-DSS would seem to have unbounded potential for military operations, and yet militaries do not have unbounded resources. With so many problems that AI-DSS could address, how do decision-makers decide where to apply AI-DSS next?

Currently, this question is being answered organically within the U.S. military, as numerous units are acquiring and experimenting with AI-DSS to solve various military challenges. That approach has advantages for rapid innovation and poses challenges for coordination and control. This series of studies does not aim to judge the efforts currently underway but instead seeks to explore the opportunities and challenges for scaling AI-DSS across multiple applications. To do this we:

- First, explore realistic AI decision support applications in areas of known military need based on an analysis of military processes and AI techniques.
- Second, highlight the challenges and tradeoffs specific to those applications.
- Third, identify scaling and adoption challenges common across any AI-DSS application for the Pentagon and offer recommendations on how to navigate those challenges.

In pursuit of exploring high-value AI-DSS applications and identifying the risks and challenges to their adoption, we began with what we know of MSS, which we studied in our previous paper and continue to examine in depth.[17] From that baseline, we asked three questions:

- What if an AI-DSS was applied to a non-targeting operations task? (This paper)
- What if an AI-DSS was used to address less tactical and more operational needs (in other words, used for upper-echelon decisions)?
- What if AI-DSS was used to improve partner and allied operations?

While MSS was our baseline case because we had the most direct access to it, our analysis seeks to transcend any one AI-DSS and provide a framework and approach for considering the utility, as well as the potential hurdles and risks to the adoption of, AI-DSS. We are not trying to detail what MSS or any AI-DSS is doing in totality today but rather to describe the key components and future directions. While the solutions we propose for our case studies do not exist, some of the specific capabilities within the case studies may be in development. We incorporated information on solutions where we had the information, though we know our analysis of current systems in use is limited, in part because of classification and because of the rapid proliferation of new AI-DSS.

Understanding AI-DSS

Identifying which military needs can benefit from AI-DSS requires understanding the functions where these systems have already demonstrated real-world effectiveness, or where the nature of the task suggests they are likely to do so. The literature on AI-DSS[18] offers no single, clean definition, but AI-DSS can be described as performing all the following six key functions shown in Table 1:

Table 1: Functions that define an AI-DSS

AI-DSS Function	Description	Examples
Ingest	Ingesting, connecting, correlating, and managing structured and unstructured information streams of a heterogeneous nature in (near) real time to maintain a continuously updated knowledge base.	● Traditional military information such as sensor reports and locational tracking information, imagery of various kinds, intelligence reports, own-force reports and position tracking, weather/environmental information and reports, logistics and readiness data, orders, briefings, and planning documents. ● Non-traditional information such as social media feeds and other information pulled directly from the internet and/or commercially procured information feeds or military chat circuits. ● Rapidly and easily ingest novel data streams that may become available during operations; connect and correlate these with existing information.
Generate	Generating insights and information from that knowledge base that is tailored to support individual users and the role they play in decision-making.	● For a tactical air defender: Report airborne objects that might pose a threat together with own-force units available to intercept. ● For a Corps-level fires officer: Report likely threats, relay priority for engagement, and suggest own-force units best able to engage. ● For a logistics planner: Report the own-force units

		most likely to run short of ammunition or other supplies and options to re-supply them. ● For a combatant commander: Highlight unusual adversary patterns or behaviors, assess the potential risks, and offer suggestions to mitigate or deter.
Enable	Enabling users to easily create individualized dashboards, reports, charts, and control panels tailored specifically to their needs to enable decision-making.	● Users create displays that enable them to rapidly understand novel situations, develop options, and then assess them. ● Users design (or redesign) workflows to reflect the needs of the commander and the situation; for example, implementing a workflow in which various steps occur in parallel, or one that is highly sequential. ● Allow watch standers to easily customize information displays to facilitate execution of their specific assigned tasks.
Automate	Automating many of the steps required to implement and execute a decision.	● At tactical levels, automate the creation and transmission of appropriately formatted target assignment messages or execution orders to relevant units. For example, MSS (upon human approval) automates the transfer of target information and fires orders to appropriate artillery units. ● At operational and strategic levels, automate the

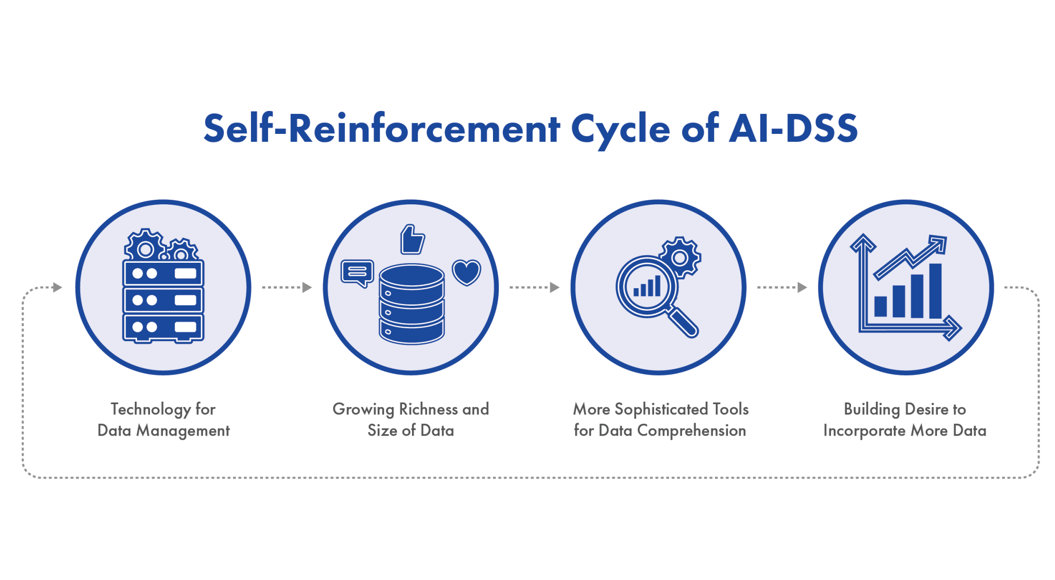
		generation of reports such as situation updates, mission reports, fragmentary orders (FRAGOs), and similar documents necessary for implementing and executing a decision.
Share	Sharing its knowledge base (in whole or part) with other authorized users to enable a common understanding of the operational environment.	• Smart filtering, redacting, and/or editing of information to be shared based on classification, need-to-know of the recipient, and/or official release guidance. • Smart prioritization of information to share with users that suffer bandwidth limitations. • Sharing smart automated summaries of essential information elements with all relevant parties.
Interface	Interfacing and interacting directly with existing information systems and combat systems to allow direct transfer and exchange of relevant data, eliminating the need for slow and error-prone manual re-entry of information.	• As an illustration of such capability, Army MSS can interface directly with Advanced Field Artillery Tactical Data System (AFATDS, the system used by Army and Marine Corps to command and control artillery fires) to obtain information about various fires units and send target assignments and fire orders. • A COCOM-level AI-DSS could directly interface with the Tactical Tomahawk Weapons Control System (TTWCS) to trigger the creation of needed Tomahawk mission planning packages, or with the Theater Battle Management Core Systems (TBMCS) or related systems to inject a commander's guidance, strategic

		intent, and priorities directly into the Air Tasking Order development processes. Or interface with logistics systems such as Military Logistics Network Planning System (MLNPS) to automatically provide updates that trigger planning/replanning of logistics operations.

AI-DSS are rapidly becoming increasingly capable because of a self-reinforcing technical cycle:

- Technology advancements are rapidly increasing our ability to incorporate more data—and more complex data—into the AI-DSS's knowledge base.
- The growing richness and size of the knowledge base in turn powers the effective use of increasingly sophisticated AI tools.
- These more sophisticated AI tools in turn make it easier for warfighters to interact with the knowledge base, explore it, understand it, and obtain the information they need to make complex decisions in a timely manner. Even as the size and complexity of the knowledge base is growing, it is becoming easier to understand and work with.
- This creates a warfighter desire to incorporate additional data sources. AI tools facilitate and accelerate the incorporation of these additional data sources into the knowledge base. The even bigger, richer knowledge base, in turn, enhances the capabilities of the various tools (whether AI-enabled or not), providing additional value to warfighters.

Figure A: Self-Reinforcement Cycle of AI-DSS



Source: CSET.

The combined effect of having a large integrated knowledge base, a tailored application of enabling AI-tools, and a flexible, adaptable way of presenting information changed the way XVIII Airborne Corps warfighters operated.[19]

Operational-Level Tasks Ripe for AI-DSS

As already highlighted, the use of MSS for deliberate targeting was successful in the case of the XVIII Airborne Corps, but there are myriad tasks in military operations that are comparable in the sense that there are workflows involving multiple people making decisions based upon information that must be collected, analyzed, and managed appropriately. The key is to identify tasks with the potential for significant improvement in effectiveness, **namely those where current processes are data-, coordination-, and manpower-intensive.** Among these, the highest impact comes from those **processes time-consuming enough to be "the pacing[*] process" in some military operations**; if AI-DSS can transform these, the improvements may not only be operationally significant, but perhaps operationally transformative. Given these criteria, two processes come to the fore as exemplars for case studies:

- **An AI-DSS for keeping Army fires units supplied with ammunition.** MSS has enabled the Army to significantly speed up the land fires process—but what if the flow of ammunition can't keep up? Planning and executing ammunition distribution effectively requires aggregating and interpreting a wide variety of dispersed information about inventories at many sites, transportation availability, and projections of future ammunition demands. It also requires cross-coordination and information exchange between units and planners—something currently done manually via voice, email, and/or chats. And the amount of coordination required to develop an ammunition resupply plan is mind-boggling, presenting a promising opportunity for a "20 doing the work of 2,000" value-add.

- **AI-DSS for the Joint Air Tasking Cycle.** At its core the Joint Air Tasking Cycle is conceptually similar to the Army fires process, but significantly more complex, requiring coordination of aircraft, aircrews and weapons, as well as supporting and enabling elements (electronic support, communications, aerial refueling, etc.). Because the current JATC is a 72-hour cycle, the potential to "do with 20 what required 2,000" could offer a path to greatly shortening the cycle and making airpower more operationally responsive.

The following sections discuss each of these case studies.

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[*] "Pacing" in the sense of most time-consuming—the proverbial "long pole in the tent".

An AI-DSS for Keeping Army Fires Units Supplied with Ammunition

MSS has demonstrated the ability for the Army to significantly speed up the land fires process[20]—but it immediately raises the question of maintaining ammunition flow to keep pace. Delivering a steady stream of ammunition to fires units requires pulling and integrating lots of information that is currently distributed across the battlespace and beyond (e.g., current inventories at fires units, caches, and depots; ordered, planned, and forecast fire missions; available transportation units and resources; current state of delivery routes and threats to these; available transport crews, etc.). It also requires coordination among those who are processing current firing orders and plans and those engaged in preparing the next set of orders. It is particularly important that all players are working from the same and most current information. An AI-DSS that simply aggregated, validated and cross-connected all this information in real time and made it available to all parties would reduce the time (and risks) of warfighters doing this manually. Implementing this could be a separate AI-DSS, but probably makes most sense as a direct extension of current MSS tools already being used for Army fires.

The major steps in the process of keeping Army fires units supplied with ammunition are summarized in Table 2.

Table 2: Army Fires Unit Ammunition Supply Process[21]

Step	Description
1	Forecasting requirements based on the operational tempo, planned targets, and enemy situation.
2	Obtaining the current status of on-hand and expended ammunition from all fires units. Currently, fires units provide this information together with projected ammunition needs out to 72 hours[22] via what are called LOGSTAT reports that detail a unit's key commodities, including fuel (Class III), ammunition (Class V), and maintenance (Class VII), providing on-hand stock, consumption rates, and project requirements for the next 24–72 hours. LOGSTAT reporting has a reputation for being incomplete and inaccurate.[23]
3	Developing and submitting the ammunition order. This is currently a manual process that involves validation of incoming data from subordinate units, coordination to understand availability at various points in the supply chain, and creation of the actual order for ammunition (Class V).[24]
4	Creating and executing a distribution plan to move ammunition from supply points to the firing units. This requires information on available/viable transport options, awareness of battlespace, and coordination with all parties involved, from ammunition supply point personnel to logistics personnel to the units receiving ammunition, as well as lower-level commanders whose battlespace may be transited by ammunition movements.[25]

Source: Department of the Army, "Fire Support and Field Artillery Operations" (U.S. Army Field Manual FM 3-09, 12 August 2024).

Today, MSS already contains the key information for step 1: the targets that are already developed and are in the process of being developed. And this information is available—in real time—to all units that can access MSS. For step 2, the Army is already attempting to address LOGSTAT deficiencies through the Army Software Factory's LOG TAK project,[26] which is working to provide faster, less error-prone, and more accurate LOGSTAT reporting via digital means. As MSS is already available to many Army fires units, incorporating LOGSTAT/LOG TAK capability into MSS would make LOGSTAT information immediately accessible across MSS, would make it updateable in near-real time, and would enable cross-connecting ammunition status information to current and futures fires plans.

Step 3 would require incorporating into MSS information on the location, status, availability, and readiness of logistics assets and ammunition supplies—basically maintaining the same types of information for logistics units and facilities that MSS already maintains in near-real time for fires units. With this information, including every update to the future fires plan and/or real-time updates on the executed fires and ammunition supplies, MSS could automatically maintain an up-to-the-minute draft ammunition order, ready for review and transmission whenever the appropriate commander decides.

Step 4 would require incorporating into MSS a live "route map" that would include relevant survivability, mobility, and countermobility data. Tools along these lines are already in development at the U.S. Army Engineer Research and Development Center (ERDC)[27] and at the U.S. Army Corps of Engineers' Army Geospatial Center[28]. Incorporating and integrating this information into MSS would enable the creation of near-real-time, at-scale planning and routing tools for the delivery of ammunition, analogous to those used by FedEx, UPS, and Amazon to manage package deliveries.*

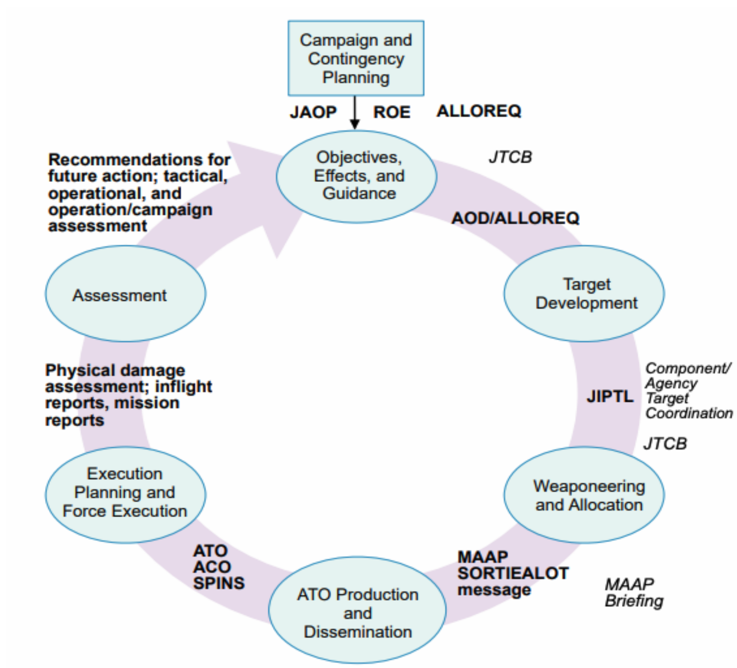
In combination, these extensions to MSS have the potential to greatly simplify and accelerate the planning of ammunition resupply. By continuously integrating and correlating information that is currently painfully managed by warfighters in Excel spreadsheets and PowerPoint slides and creating tools to automate the information-intensive aspects of the logistics planning processes—and making all this information available to operators at all levels—this has the potential to yield important improvements in the quality and speed of decision-making.

* See Appendix C for an overview of commercial sector delivery scheduling.

Applying an AI-DSS to the Joint Air Tasking Cycle

Bringing an AI-DSS to the process used for the deliberate planning of air power to strike targets is a much more ambitious effort but also has the potential to deliver major value-add to the entire Joint Force. The JATC (Figure 1) is conceptually similar to the Army's fires process, but the JATC operates on a larger scale and is significantly more complex. The JATC routinely manages hundreds of targets per cycle, with the planning for each target requiring coordination across aircraft, weapons loadouts, aircrew assignments, communications frequencies and callsigns, and airborne tanking support. This also requires the creation of complex documents providing the tasking and supporting information for the many elements involved—primarily the "Air Tasking Order" and associated "Special Instructions." The Air Tasking Order (ATO) is a directive that specifies the air missions to be flown over a 24-hour period, while the Special Instructions (SPINS) provide detailed supplemental guidance on specific procedures, airspace rules, communication protocols, etc.*

Figure 1: Joint Air Tasking Cycle (JATC)



Source: Joint Publication 3-30, *Joint Air Operations*, Fig. C-1, p. C-4. (See following text and Appendix D for explanation of the acronyms).

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* Other important documents in the process include the Air Operations Directive (AOD), the Master Air Attack Plan (MAAP), and the Airspace Control Order (ACO).

Developing the ATO is manpower-intensive and time-consuming. The process must first match targets to weapons best suited to achieve the desired effects on that target.[*] The weapons must then be matched to the aircraft best suited to successfully deliver them, in view of the air defenses and the environment the aircraft must fly through. The aircraft must then be matched with appropriate aircrew and supporting aircraft (as needed) to provide escort, electronic warfare effects, real-time surveillance, and/or on-call Combat Search and Rescue (CSAR). All these aircraft need corresponding airborne tankers (and tanking plans) for refueling, as well as plans for communications, command, and control. Often, optimal matchings are not possible for all targets, requiring iteration to achieve a suitable and executable plan. Figure 2 lays out the air tasking cycle timeline and shows where ATO creation and dissemination fall in the process.

Because of this complexity, the timeline for executing a Joint Air Tasking Cycle is 72 hours. This means that, even when the system works perfectly, *it will take three or four days* from the time higher headquarters guidance is received until the air component strikes a target. This delay has been the cause of frustration for senior commanders: One of the authors personally observed the repeated frustration this caused General Tommy Franks during Operation Iraqi Freedom in the March–April 2003 timeframe. These timelines were first established during the Vietnam War and reaffirmed in recent U.S. Joint Doctrine on Targeting (2018)[29] and an Air Force manual for the operation of the Air Operations Center (2024).[30] The long timeline has remained entrenched because of the complexity of the planning and the limitations of existing tools.

Experienced practitioners may note that the JATC process is only for *deliberate targeting*—in other words, only those targets that are ready "in sufficient time"[31] for the JATC process—whereas there is a separate process for *dynamic targeting*, which applies to unanticipated targets outside of the preplanned list.[32] While it is true that the dynamic targeting process can accommodate targets in under 72 hours, the number that may be accommodated is quite limited. Only a small number of "on-call" or alert aircraft are reserved for such emergent tasks. In actual operations, many deliberate targets identified and planned long in advance may suddenly rise in priority (e.g., planned to attack a number of targets on a future date, but the combatant commander

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[*]The appropriate weapon depends on both the kind of target and the desired level of destruction. A tank, a radar, a building, or a reinforced bunker each require different types and/or numbers of weapons. If, for example, the target is a building, the selected weapon(s) will depend on whether the intent is to make the building temporarily unusable, permanently unusable, or to destroy the internal contents of the building.

now desires those targets to be hit in the next 24–48 hours). While the current JATC processes will accommodate some late re-shuffling of targets, it will struggle to accommodate the re-shuffling of dozens of targets with only 24–48 hours advanced notice; these are usually inappropriate (and too many) to handle as dynamic targets, and it's too late in the deliberate planning process to swap out dozens of targets.[*]

For this reason, accelerating the JATC process and making it more flexible would bring clear operational advantages to warfighters and the opportunity to revisit the doctrinal 72-hour timeline.

To better understand the opportunities and challenges for AI-DSS in this case study, we examine more closely the 72-hour cycle period from the delivery of the guidance to the start of Air Tasking Order (ATO) execution in Figure 2. Note that while Figure 2 comes from a Joint document, the corresponding Air Force documents reflect the same timeline and key events (see Appendix A for a comparison of Joint and Air Force descriptions). The ATO is the document that formally tasks all the aviation sorties for a 24-hour period, and it is often seen as the culminating product of the JATC.[33]

The Theater Battle Management Core System (TBMCS) has been the Air Force's ATO-building program of record for decades. The Air Force has been developing and deploying modern digital tools to enhance, extend, and or complement TBMCS capabilities. Appendix B highlights the various Air Force efforts we have identified in open reporting. Some of these are AI-enabled, but none of them appear to provide an overarching AI-DSS capability to manage the Air Tasking Cycle processes.

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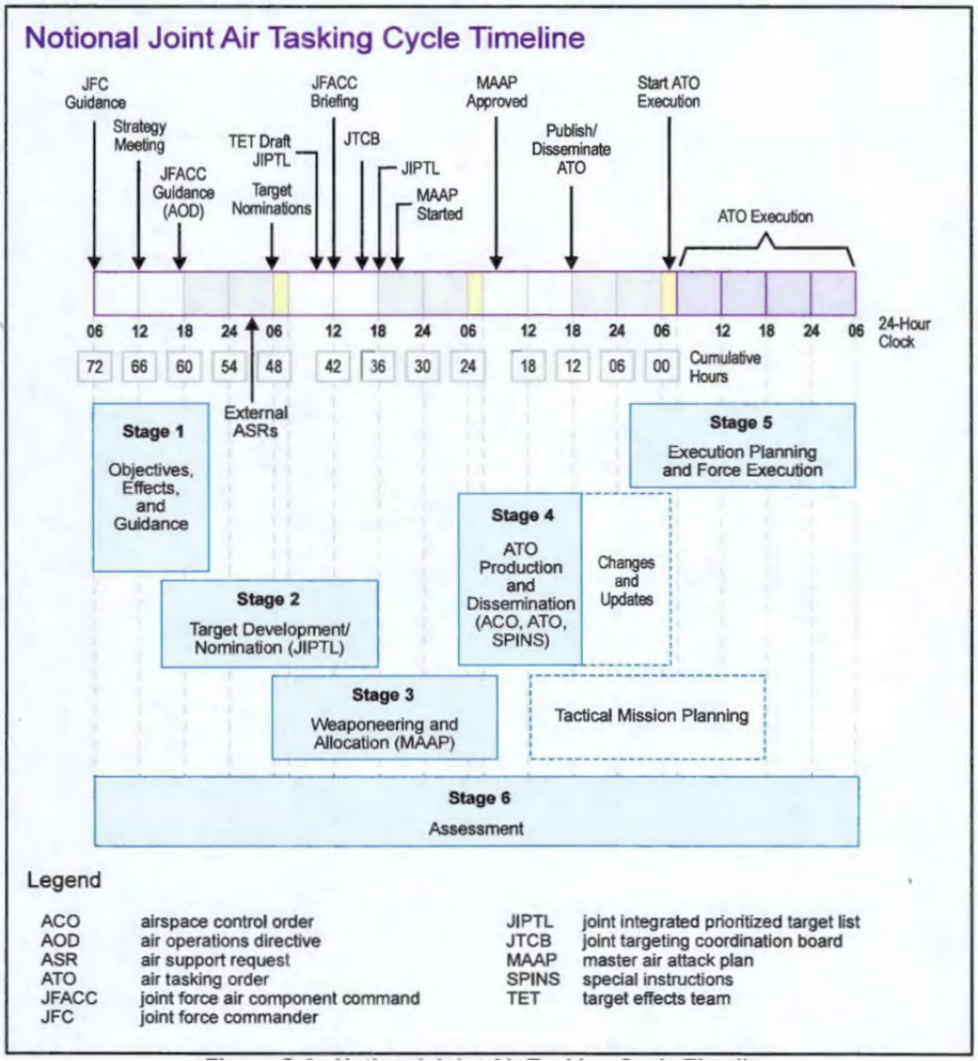
[*]Having to wait three or four days to hit a couple dozen existing targets that had newly become priorities instead of inserting them in place of now-lower-priority targets in tomorrow's or the day after's ATO was a significant source of frustration to General Tommy Franks during OIF, as observed at the time by one of the authors.

Figure 2. The Notional Joint Air Tasking Cycle Timeline



Source: Joint Publication 3-60, *Joint Targeting*, Fig. C-2, p. C-5. (See following text and Appendix D for explanation of the acronyms.)

Focusing specifically on the process to generate the ATO, creating an AI-DSS to support ATO generation is in principle not fundamentally different from what must be done to expand MSS to incorporate Army ammunition resupply, but it is a much larger undertaking. As shown in Figure 2, the process consists of five sequential but overlapping stages (1–5) and one continuously ongoing stage (6), summarized in Table 3 below. In this table, we have split Stage 3 (Weaponeering & Allocation) into two sub-stages, 3A (Weaponeering) and 3B (Allocation) to facilitate discussion of each of these aspects separately (recognizing that in practice these two are integrated). The subsections following the table go into greater detail on how AI-DSS is relevant for Stages 2, 3A, 3B, and 4.

Table 3: Stages of the Joint Air Tasking Cycle process

Stage	Countdown to Execution (Duration)	Purpose	Key Output(s)	AI-DSS Opportunity
1. Objectives & Guidance	72–60 hrs (12 hrs)	Strategic planning that translates guidance into refined direction.	Air Operations Directive (AOD).	Not a focus of this paper (primarily strategic planning).*
2. Target Development & Nomination	60–36 hrs (24 hrs)	Develop, nominate, and prioritize targets aligned with priorities.	Joint Integrated Prioritized Target List (JIPTL).	**High value:** Replace Excel/PowerPoint workflow with a single data management platform; auto-sync data across commands; generate exports and slides on demand; eliminate version-control errors that risk collateral damage or fratricide.
3. Weaponeering & Allocation	48–18 hrs (30 hrs)	See 3A and 3B below.	See 3A and 3B below.	See 3A and 3B below.

*As indicated earlier, a forthcoming paper focused on how AI-DSS may contribute to the strategic level of warfighting and/or facilitate coordination and collaboration between the operational and strategic levels may offer perspectives relevant to Stage 1.

3A. Weaponeering	See 3 above	Determine weapons needed for each target; match targets and weapons to available aircraft units; coordinate loadouts.	Inputs to the Air Battle Plan (ABP).	AI-DSS cannot replace warfighter mission planning judgment, but AI-DSS can assemble information on the availability of weapons, aircraft, aircrew, refueling, etc., in one system accessible to all. This will speed AOC–unit coordination and planning, and facilitate more dynamic scheduling.
3B. Allocation	See 3 above	Allocate and sequence available assets across all planned missions.	Master Air Attack Plan (MAAP) (issued 24-hrs prior to execution).	**High value:** Ideally suited for AI-DSS—analogous to the routing/scheduling algorithms used by FedEx, UPS, and Amazon for large-scale delivery.
4. ATO Production & Dissemination	18–12 hrs (6 hrs)	Translate MAAP into detailed, executable orders (refueling, callsigns, frequencies, ACMs, etc.)	Air Tasking Order (ATO) Special Instructions (SPINS) Airspace Control Order (ACO).	**High value:** AI-DSS can auto-generate complex documents containing tedious details and rigid formats (ATO and ACO) as well as more human-readable documents (SPINS). AI-DSS can auto-apply foreign release rules to produce tailored versions of these suitable for partner nations.

5. Execution	0 hrs (24 hr execution day)	Execute missions, monitor situation, adapt to events.	Actual sorties flown and real-time command and control.	Not a focus of this paper. Common Operating Picture and information correlation and management are already supported by existing tools.
6. Assessment	During execution and after	Correlate intelligence, ISR, and open-source data to assess mission effects.	MISREPs feeding the next JIPTL cycle Battle Damage Assessment (BDA).	Not a focus of this paper. Already supported by tools like MSS; LLMs/AI agents have the potential to further accelerate BDA and MISREP processing.

Stage 2: Target Development & Nomination

In Stage 2, targets are developed, nominated, and prioritized to support the objectives and priorities established in the Air Operations Directive (AOD). The product of Stage 2 is the Joint Integrated Prioritized Target List (JIPTL).

Stage 2 consumes about 24 hours of the notional 72-hour Joint Air Tasking Cycle. It overlaps with Stages 1 and 3, notionally starting 60 hours prior to execution and ending 36 hours prior.

In recent implementations of the JATC process, most of the coordination and planning that creates the JIPTL has been done using Excel spreadsheets and PowerPoint slides. These have historically proven time-consuming to create, notoriously difficult to keep synchronized (both between the Excel and PowerPoint products, and between the versions of each held at different commands), and almost impossible to keep up to date with the most current data. While the use of “shared drives” in theory allows everyone to revise the same master copy, in practice classification, compartmentation, and communications limitations often force operators to revise distinct copies of the documents, causing a burden and delay to synchronize changes. These version control issues can lead to costly mistakes; for example, if new information results in a target being removed from the JIPTL and placed on the No-Strike List (NSL), working from an obsolete version of the JIPTL and/or NSL can lead to collateral damage, civilian harm, or even fratricide.

In Stage 2, AI-DSS offers the opportunity to manage all the information relevant to targeting (intelligence reports, government and commercial imagery, ELINT, battle damage assessments, field reporting, mission reporting, etc.) in a single system, allowing all commanders to have the most current information on all targets at their fingertips, and to manipulate and visualize it as they see fit. Like MSS does for the Army fires process, an AOC-focused AI-DSS can generate data exports as needed to either transfer information to other non-connected systems or to make the information available as local spreadsheets. And if PowerPoint slides are desired to support briefings, senior officer discussions, and/or decision meetings, AI-enabled tools can be used to generate PowerPoint slides at the click of a mouse from the common knowledge base using whatever template is desired, or to support briefing directly from AI-DSS visualizations, as opposed to transferring data to PowerPoint slides.[*]

Stage 3: Weaponeering & Allocation

Stage 3 determines the weapons that should be used to achieve the JIPTL's objectives and then determines how to allocate available aviation resources to deliver those weapons. These two sub-stages—weaponeering and allocation—provide very different opportunities for AI-DSS tools, so these are discussed separately below.

Note that Stage 3 consumes about 30 hours of the notional 72-hour Joint Air Tasking Cycle. It overlaps with Stages 2 and 4, notionally starting at 48 hours prior to execution and ending at 18 hours prior to execution.

Sub-Stage 3A: Weaponeering

In conducting the weaponeering and detailed mission planning for each JIPTL target, planners require inputs such as available weapons, aircraft available to deliver weapons to targets, aircrews available to pilot aircraft, aircraft available to perform supporting missions, airborne tankers, fuel available, etc., as well as guidance and parameters for collateral damage assessment. Knowing exactly what will be available on day-of ATO execution is in practice impractical, so commonly aviation units instead preplan with the Air Operations Center (AOC) to provide daily a set number of sorties of specific aircraft type(s), each configured to carry a preplanned "general purpose" weapon load. AOC planners make an initial determination of the weapons each JIPTL target requires and use the "preplanned sorties" to match targets to specific units and delegate detailed mission planning to those units. If either AOC or unit planners determine a target requires a unique weapons loadout, this triggers human interactions between AOC planners and the unit(s) involved to obtain information and coordinate/iterate as needed to finalize mission planning for that target (or, if needed, reassign the target to another unit). With this coordination complete, AOC planners can consolidate the weaponeering and mission planning for all the JIPTL targets and establish the overall Air Battle Plan (ABP) for the current cycle.

AI-DSS tools are unlikely to reliably perform weaponeering and associated tactical mission planning (these still require experienced warfighters), but an AI-DSS can

[*] Several four- and three-star military headquarters already report and brief using MSS to directly visualize and present information during briefings instead of generating PowerPoint slides.

support Stage 3A by assembling and integrating information and making it immediately available to both warfighters at the AOC and the individual aviation units, saving the time and manpower currently spent maintaining and accessing this information.

Sub-Stage 3B: Allocation

In developing the allocation, planners review the totality of available resources (aircraft, aircrews, weapons, etc.) and the resources required by the totality of missions planned in Stage 3A, then they figure out how to allocate and sequence the available assets across the missions that need to be flown. The product of this stage is the Master Air Attack Plan (MAAP). The MAAP is in effect a master delivery plan detailing the targets, the set of aircraft and weapons assigned in direct and/or supporting roles to the mission against each target, and the appropriate sequencing and scheduling.

AI-DSS tools are ideally suited to creating plans such as the MAAP. The problem of delivering packages (weapons) from warehouses (bases) to delivery locations (targets) using a fleet of delivery platforms (aviation resources) is one that has proven algorithmic solutions. Every day, companies such as FedEx, UPS, and Amazon use algorithms to schedule and manage daily deliveries on a massive scale (see appendix C). The JATC needs similar tools to be brought to bear.

Stage 4: ATO Production & Dissemination

Stage 4 generates and disseminates the three key documents that execute the MAAP:

- the Air Tasking Order (ATO), the detailed, executable daily order that translates the MAAP into a concrete schedule of specific missions, assigning aircraft, call signs, times, and routes to execute specific tasks;
- the Special Instructions (SPINS), providing detailed, mission-specific instructions, procedures, and directives needed by units to execute their assigned missions safely and effectively; and
- the Airspace Control Order (ACO), providing airspace control measures (ACMs) such as corridors, altitudes, and restricted areas, as part of the coordination and deconfliction for all airspace users.

Examples of what an Air Tasking Order contains:

- Mission data: Mission numbers, specific aircraft types, and the number of aircraft assigned to each mission/task.
- Operational identifiers: Individual call signs for aircraft and units, as well as identification friend or foe (IFF/SIF) modes and codes.
- Targeting information: Precise target locations, target types, and times on/off target.
- Mission types: The specific nature of the flight, such as close air support, air refueling, air-to-air combat, or reconnaissance.
- Control and coordination: Frequencies for communication, the controlling agencies responsible for oversight, and report-in points.
- Logistical support: Specifics for airborne refueling, including airborne tanker call signs, air refueling control points, and the various fuel off-loads for each aircraft refueled.

The transition from the MAAP (which is a plan) to the ATO (which provides specific execution instructions) involves a myriad of details. The ATO not only schedules the when and where for all the aircraft that will fly, it specifies when each aircraft will refuel and from which tanker aircraft; and when and where supporting aircraft will provide specific services (such as ISR, EW, C2, etc.) and to whom. The ATO also specifies numerous other details such as callsigns for all aircraft and the specific communication frequencies to be used. Generating these details is a methodical but tedious and error-prone task—precisely the kind of task that is challenging and time-consuming for humans but easy and quick for computers.

All these details then need to be translated into the three key output documents. These are complex, inter-related documents following the United States Message Text Formatting (USMTF) program standard and distributed in both legacy formats and XML-based representations (XML-MTF).[34] These three documents are currently generated from the MAAP by the TBMCS system.

A future AI-DSS that addresses the allocation-and-schedule problem and generates the MAAP can also auto-generate all the implementation details as well as these output documents, either by leveraging existing tools for this purpose* or by developing new and improved versions that tap directly into the underlying knowledge base of the AI-DSS tool. The ATO and ACO are rigidly structured with limited room for freeform information (they are designed to be "read" by machines rather than by humans), so existing generation tools are likely to suffice.[35] The SPINS, however, is often written for human reading,[36] and may benefit from tailormade natural-language processing (NLP) or generative AI tools that comprehend the specialized English of aviators and generate appropriately tailored English language output. Furthermore, AI-DSS can use AI tools to apply foreign release guidance rules automatically to generate versions of these three documents appropriately tailored to each foreign partner, or (if preferred) a single version releasable to all partner nations.[37]

* For example, by leveraging tools in TBMCS that currently generate the ATO, SPINS, and ACO.

Expected Operational Benefits of AI-DSS

Applying AI-DSS to our case studies would bring a series of operational benefits which fall into four broad categories:

1. Reduction of errors due to re-entry of data or loss of version control
2. Manpower efficiencies
3. Net process speed-up
4. Increased process flexibility

In both case studies, moving the entire process into an AI-DSS digitizes it and creates a single shared data source that is continuously correlated and cross-checked, eliminating the synchronization and version control problems that arise from notes and ad-hoc spreadsheets, and reducing errors, wasted staff time, and frustration for action officers and senior leaders alike.

The following subsections summarize the latter three benefits for each case study.

Benefits of AI-DSS Support to Army Fires Resupply

As described earlier, an AI-DSS supporting ammunition resupply to Army fires would free many of the warfighters currently involved in the tedious process of collecting, aggregating, and cross-checking information. Warfighters working countless hours to develop (and redevelop) delivery plans would be supported by an AI-DSS that can generate an overall delivery plan in minutes. This allows warfighters to focus on reviewing the products and iterating/refining the plan. Manpower no longer required for review and coordination can be repurposed to other warfighter roles.

Automation support to the delivery planning process is the primary source of both the significant process speed-up and increased flexibility. An AI-DSS incorporating the kinds of tools used by commercial delivery services can generate delivery plans in minutes. Depending on operational circumstances, the time saved can be used to respond more rapidly to battlefield circumstances, or to spend more time reviewing plans and exploring alternative options than current processes allow.

Because delivery planning with AI-DSS takes minutes, it also becomes more flexible: New plans are easier to generate when faced with late-breaking changes (computers are great at working through cascading changes), implications can be rapidly assessed, and decisions are disseminated nearly instantly.

Benefits of AI-DSS Support for JATC

The bottom line is that an AI-DSS would reduce manning, accelerate steps that currently consume 60 hours of the notional 72-hour JATC timeline, and add a level of flexibility to the existing rigid 72-hour timeline of the JATC cycle. We address each of these in turn.

Manpower Efficiencies

A dissertation published by the Air Force Institute of Technology (AFIT) documents the significant manpower requirements of JATC processes and makes clear that manpower is a limiting factor in the process.[38] An AI-DSS tool would free warfighters from performing most of the tedious, mechanical aspects of the process, specifically:

- Stage 2 (JIPTL generation). This stage is analogous to what MSS has already achieved in developing and prioritizing targets for ground fires. Using AI-DSS to support Stage 2 of the JATC process would be expected to result in corresponding manpower savings.

- Stage 3A (Weaponeering). The task of assembling necessary information is currently performed largely by warfighters conducting direct reach-back and coordination with individual units. An AI-DSS that puts this information at the warfighter's fingertips would largely eliminate this tedious task, reducing overall manpower requirements.

- Stage 3B (Allocation). The allocation and scheduling stage of the JATC process would be largely automated, as is done in the commercial sector. Freed from the mechanics of allocation and scheduling, warfighters could focus on oversight and review, and overall manpower would be reduced.

- Stage 4: (ATO generation and dissemination). ATO, ACO, and SPINS generation would become close to a push-button operation. Yet again, this would allow warfighters to focus on oversight and reduce overall manpower requirements.

Process Speed-up

AI-DSS also brings potentially significant process acceleration. While all the stages in question would be speedier, the most significant improvements would be in Stage 2, Stage 3B, and Stage 4, specifically:

- Stage 2 (JIPTL generation). The experience we saw with the XVIII Airborne using MSS showed significant speed-up in the process. We would expect the same here.

- Stage 3B (Allocation). The allocation and scheduling process would be largely automated, making it possible to generate an allocation and schedule in minutes, not hours. This would require review and iteration, but the process might only take a few hours instead of the current 12 to 18 hours as implied by the AFIT study.

- Stage 4 (ATO generation and dissemination). ATO, ACO, and SPINS generation (as well as generation of corresponding briefing products) would become a push-button operation, reducing the time required only to that needed to review and approve the products.

Improved Process Flexibility

Applying AI-DSS tools would address a longstanding frustration with the existing JATC process: the difficulty of making additions to the target set after the JIPTL has been "locked" at 36 hours prior to execution. The biggest challenge to incorporating additional targets late in the JATC cycle is the allocation and scheduling process (Stage 3B).

Currently, introducing a corresponding new mission into the existing allocation and schedule requires a complex set of changes that cascade throughout the entire plan. Aircraft must be pulled from their original target/missions to this new one. It is impractical in all but the simplest cases for warfighters to work through the many cascading changes to implement such a change in the time available. An AI-DSS can help clear this obstacle by conducting the change analysis quickly and reliably and presenting options for the necessary changes in an understandable way to the warfighter. This is exactly what commercial sector package delivery providers such as FedEx, Amazon, and UPS do on a continuous basis as new packages, especially higher-priority packages, enter their system (see Appendix C).

Expected Operational Risks

Our discussion up to this point has focused on expected operational advantages of AI-DSS, but it is critical to consider the risks that come with these advantages. Current military technologies and processes are not perfect, but their flaws are relatively well understood, even if imperfectly addressed. By contrast, the flaws inherent to AI-DSS and the processes they will reshape are new and not yet well understood or characterized. Uncertainty notwithstanding, leaders considering AI-DSS adoption must weigh known and theorized risks against known or perceived advantages.

A brief inventory of risks with deploying AI-DSS generally, and more specifically with AI-DSS to support fires resupply or the JATC, includes:

- **Diminished warfighter critical thinking and cognitive offloading.** Cognitive offloading is an everyday process whereby individuals take actions to reduce demands on their cognitive processing—everything from counting on fingers to creating automatic meeting reminders to relying on social networks or staffs for information.[39] While such offloading is expected and commonplace, especially in complex military decision-making, academic studies are showing that high cognitive offloading through the use of AI tools correlates to lower critical thinking scores.[40]

- **Automation bias and unjustified confidence.** Related to critical thinking, automation bias is the tendency for humans to over-rely on computer-generated solutions, a phenomenon well-documented in academic literature and operational studies.[41]

- **Pressure to further reduce the time and people in decision cycles.** People and time are still necessary for complex judgement calls, but capable AI-DSS that demonstrate the ability to move and synthesize information may cause leadership to underestimate the number of people involved and the expectations of time for making judgement calls. While AI accelerates and eases parts of the decision process, it does not necessarily do so to all steps equally. This could not only erode human agency over AI-DSS but render militaries less resilient in the face of an AI-DSS failure.[42]

- **Less time spent cross-checking information.** Generations of military officers learned (sometimes painfully) to double-check information they receive. But the flood of information they are presented with today, combined with time pressure and multitude of demands on their attention, makes it increasingly difficult for them to do so. An AI-DSS in theory makes it easier to do such double-checking, but in a variant of automation bias, the idea that the AI-DSS "already cross-checks everything" may result in under-emphasizing human efforts to cross-check and validate information.

- **Data failures** (in either biased or incomplete training data or the operational data (e.g. sensors) available for decision-making). AI systems will not perform as intended if the data they trained on is not representative of the situation they are used in. Classic examples include using an AI image classifier trained on data from winter or European environments to find tanks in a desert environment. Similarly, AI systems will not perform well if the incoming sensor data during operations is insufficient, poisoned, or significantly different from what the AI was trained with. For example, an AI image classifier trained using high-resolution images may not perform well if, in combat, the only imagery available is low resolution.

- **AI failures** (of which there are many, including narrow operational windows/fragility outside training data, state decay, context drift, hallucinations, and many more).[43] While many of these AI failure mechanisms are known and documented, we generally do not have the tools yet to automatically detect such failures or warn the operators when AI outputs are more likely to be erroneous. Confidence estimates are available for AI tools such as AI classifiers, but even these are often dubious: They can report wrong classifications with high confidence.[44] Moreover, AI failures, especially for large language models (LLMs) and AI agents, continue to rapidly evolve as new techniques are implemented.

These risks are a source of substantial concern within the military[45] and civil society.[46] This list is not all inclusive but should serve as a caution that while AI-DSS do pose advantages, their risks must be thoroughly considered and addressed. Moreover, some of these risks are still ill-defined or simply unknown, as AI is rapidly evolving and safety researchers race to keep up with new risks.

The task of designing the engineering technologies, processes, and training regimes to mitigate or avoid these risks is both imperative and likely to be an ongoing challenge that requires attention. The proposed applications of AI-DSS in this paper, for example, seek to avoid some of these risks though narrowly constrained roles for LLMs, where hallucination can be minimized (e.g., to generate sanitized versions of documents for release to partner nations). In other cases, automation bias could be at least partially addressed through well-designed user interfaces, and training and certification programs.[47] Even with narrow LLM applications, trained and certified operators, and continuous evaluation and testing, retraining (of algorithms and people) will be essential to maintaining acceptable operations.

Finally, it bears mention that there are special concerns about the impact of AI on civilian populations and the potential for collateral damage. Studies have examined the root causes of civilian harm during U.S. military operations[48] and identified how AI tools can actually help mitigate such harms.[49] It is also true that AI tools could potentially increase the risk of civilian harm due to the issues we listed above. The net effect of AI-DSS on civilian harm will largely come down to how military and political leaders ensure the quality of implementation and the quality of human oversight.

Implementation Challenges

AI-DSS potential in our two cases is real, and so are the implementation risks and challenges. The hardest challenges are not technical, but rather the systemic institutional obstacles that frustrate any digital transformation: culture change, securing budgets, the requirements and procurement cycle, competition with existing programs of record and established prime contractors, and bureaucracy that can at times be insurmountable for software companies outside of defense industrial networks.

Specific to our proposed case studies, two broad categories of implementation challenges need discussion: software development and data access. Regarding software development, both case studies require quite a bit of software to be implemented (especially for an AI-DSS supporting JATC). But neither of these present novel challenges: Software systems with such capabilities (at equivalent scale and scope) already exist. However, regarding accessing data, there are significant challenges. The following sections expand on these statements.

Software Development

Our case studies depend on three core software-enabled capabilities:

1. Common to both case studies is the capability for a fully digital process that automates the correlation and fusing of information to identify targets, builds and shares target folders, and facilitates development of a prioritized target list (note that for the first case study, MSS already provides this).

2. The Army fires ammunition resupply case study envisions an AI-DSS capability to track actual and projected artillery and missile munition expenditures by the various Army fires units, automate munitions ordering, track resources available to deliver those munitions, and generate delivery plans ready to be executed by the relevant units. In short, it automates the planning and scheduling for ordnance resupply of Army fires units using available logistical resources.

3. The JATC case study envisions an AI-DSS capability that takes as inputs a prioritized target list, the mission packages designed for each target, and the aviation resources available (including weapons, aircraft, and aircrews), and automatically perform the allocation and scheduling, generating the necessary MAAP, ATO, ACO, and SPINS documents. In short, it automates the planning and scheduling for delivery of weapons to targets using available aviation resources.

The latter two capabilities both involve automating delivery schedule planning: generating a plan that uses available delivery resources to deliver packages to various locations on schedule. The two capabilities differ in what is being delivered and the kinds of resources that make the deliveries, as well as their scale and complexity, but from a mathematical/algorithmic perspective, these are the same.

None of these three capabilities are novel. In fact, software systems performing all three of these are capabilities being used in the real world today. The XVIII Airborne Corps's MSS already does #1 for land fires. The private sector (e.g., UPS Ground Delivery) solves #2-type problems daily. UPS, of course, doesn't deliver in contested environments or off-road, but the Army is already making investments to figure out the off-road and contested environment "routing" problem.[50] As for #3, companies such as Amazon and FedEx already rely on software systems to allocate package deliveries to available resources, schedule them, and manage the execution of deliveries in near-real time and on a global scale.[*]

Proven examples of such tools exist, but we also acknowledge that significant development work is required to adapt and/or reimplement them for use by the U.S. military. Because warfighters who execute these processes day-in and day-out understand them best, they must work alongside developers (ideally using something like the DevSecOps process that the XVIII Airborne used to develop MSS) to adapt proven private sector "exemplars" to address the specific military needs. There is software development work to be done here, but the path has clear precedents and working examples in the private sector. The services are already taking initial steps in this direction (see Appendix B for Air Force examples).

Data Access

The big challenge lies not in the development of these AI and/or software tools, but rather in the collection and integration of data—specifically data about friendly forces—that these tools need to work properly. As highlighted previously, using AI-DSS to address the resupply of Army fires units requires a near-real-time knowledge base that includes:

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[*] See Appendix C for an overview of commercial sector delivery scheduling.

- Forecasted Army ordnance requirements based on the operational tempo, planned targets, and enemy situation (these could be generated by MSS based on current fire plans and projections).
- The current status of on-hand and expended ammunition from all fires units, as well as munition depots and/or supply points.
- The current inventory of ammunition from all munition depots and/or supply points up and down the supply chain, as well as in-transit inventories.
- Information on available/viable transport resources; the route network; its status, condition, and security; and the status of logistics personnel and escort forces available.

The AI-DSS that enables the Joint Air Tasking Cycle by generating the MAAP, ATO, etc., would need a knowledge base that includes near-real-time information on:

- Aircraft availability, readiness and weapon capabilities and compatibilities (or lift capacity or other relevant measures) at the airframe level.
- Aircrew availability, readiness, qualifications/certifications, etc., at the individual level.
- Weapons inventory/availability by location, type, series, variant, etc.
- Aviation fuel inventory/availability by location and fuel type, and tanker aircraft inventory/availability to deliver it via airborne refueling.

All the information above exists somewhere in the U.S. force—but it currently does not exist in one single organized, correlated, cross-reference knowledge base that is available to all relevant operators. It exists in individual Army transport companies, depots, or fires units. It exists at the Air Force squadron level, or in the files of the ground crews that service the aircraft. And at these levels, this data is often considered locally held administrative data. In today's warfighting environment, ***it is not administrative information—it is warfighting information.***

Illustrative Example: Why crew-level information needs to be treated as warfighting information

An AI-DSS tool designed to allocate and schedule the ATO needs to service target XYZ. Target XYZ requires delivery of four AGM-158B JASSM-ERs, a weapon requiring specific aircrew qualification. The AI-DSS finds Squadron ABC has two available F-35s that can each carry two AGM-158B, and there are two available pilots to fly those aircraft. But unless the information on their specific pilot qualifications is in the AI-DSS's knowledge base*, the AI-DSS doesn't know whether those two pilots are currently qualified to employ the AGM-158B unless someone reaches out to the squadron and asks them.*

Companies such as DHL, Amazon, UPS, and FedEx are able to implement and operate their sophisticated scheduling tools because they have something that the Air Force currently lacks: a modern data infrastructure that collects and collates all the relevant information about the organization's resources and infrastructure in real time and integrates it all in a consolidated knowledge base.[*]

Centralizing all such information in a knowledge base is the essential prerequisite to implementing and deploying effective and successful AI-DSS to address the big operational planning tasks.

Integration

Any AI-DSS will need to be integrated into existing operational command-and-control ecosystems. This includes not only integration into operational architectures and data environments, but also into command workflows. An AI-DSS supporting Army ordinance resupply to fire units will need to interface with existing MSS efforts as well as Army programs such as Global Combat Support System-Army (GCSS-Army), C2 Fix, and Next Generation Command and Control (NGC2). Similarly, an AI-DSS supporting the JATC will need to interface with and/or leverage existing Air Force programs such as TBMCS and the other programs and systems described in Appendix B. TBMCS in particular is a longstanding program of record; whether an AI-

[*] See Appendix B for a summary of the various Air Force efforts to bring cutting-edge digital technologies to the Air Operations Center.

DSS such as described here should eventually integrate into, complement, or at some point replace TBMCS is an important issue beyond the scope of this paper. It highlights the institutional challenges to adoption that are more likely than technical issues to constrain adoption at scale.

Integration with command workflows is particularly important. An AI-DSS will have little chance of successful adoption unless it directly supports existing doctrinal workflows and procedures and can be easily tailored to unit- or operation-specific workflows. However, the real benefit of AI-DSS lies in enabling new and improved staff workflows, changes in decision authorities, and enhanced human-machine integration. Process acceleration rarely yields significant operational improvement unless decision roles, validation responsibilities, and human oversight structures are adapted accordingly.

Potential Next Steps

The biggest obstacle unique to implementing the case studies described in this paper is centrally and continuously collecting, correlating, organizing, and distributing the military's own data in near-real time.* Today the U.S. military has globally distributed "common operating picture" information on units and their locations. But, as discussed in the previous section, the more detailed information (e.g., capabilities, logistics, maintenance, and personnel information) is not continuously collected nor readily available. Effective AI-DSS tools for our case studies require information that today may often exist in disparate reports. Thus, a prerequisite to applying AI-DSS to these problems is to digitize these reports (if not already digital), translate them to standardized formats, put the information in an accessible place, and convert it into real-time data feeds to be ingested by an AI-DSS that cross-checks and correlates all this information. This is exactly what the major commercial package delivery companies do regarding information on their vehicles, warehouses, and workers.

With AI-DSS supporting the JATC process, warfighters would be able to focus on detailed planning of specific missions as well as larger strategic and operational issues rather than the tedious, mechanical aspects of the current processes. The net result would free warfighters to focus on tasks requiring human judgement as opposed to data-intensive work better suited to machines.

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* The problem of institutional and cultural obstacles is unfortunately common to any new technology.

What might mission planners need to know?

These are simplified examples of "last-minute questions" based on real-world experiences of the authors.

- Are the aircraft available for this mission certified to employ this weapon?
- A ship just reported half of its VLS cells are not operational; which TLAM variants remain available in the operational cells?
- Are there fuel drop tanks available to put on these aircraft to extend their range?
- If we substitute weapon ABC for XYZ, are the aircrew qualified to employ it?

The obstacle to integrating more data regarding our own forces, whether it is detailed logistical information or personnel information at the level of individual qualifications, **is primarily bureaucratic.** It is not uncommon for the data owners to be reluctant in sharing data they have curated and managed. Will others misunderstand it and perhaps use it incorrectly; will they find errors in it; do they understand its limitations? These are reasonable concerns, but the solution is not to restrict access to the data but rather to participate actively in the process of figuring out how to ingest the data so that the AI-DSS platforms are designed to employ it responsibly.

Given the current urgency to accelerate AI-DSS adoption, it is more important than ever to move quickly to demolish these bureaucratic barriers, and Secretary Hegseth's Memorandum of January 9, 2026, provides explicit direction to do this:[51]

> *I direct the CDAO to enforce, and all DoW Components to comply with, the 'DoD Data Decrees' to further unlock our data for AI exploitation and mission advantage. Military Departments and Components will establish, maintain, and update federated data catalogs, exposing their system interfaces, data assets, and access mechanisms across all classification levels.*

This has been a longstanding challenge because the Department's data lives in stove pipes that often go down to individual units and are controlled by owners that zealously guard that data. Twenty years ago, the Quadrennial Defense Review highlighted this problem and the obstacle it presented to achieving the Global Information Grid (GIG).[52] One of the "QDR Decisions" was to:

> *Strengthen its data strategy — including the development of common data lexicons, standards, organization, and categorization — to improve information sharing and information assurance, and extend it across a multitude of domains, ranging from intelligence to personnel systems.*[53]

Since then, there has been continued emphasis on data sharing and other relevant DoD directives and instructions have been issued to promote, facilitate, and/or direct data sharing.[54] Most recently, the emphasis included 2021 guidance from a Deputy Secretary memorandum on "Creating Data Advantage" and 2026 guidance from the Secretary embedded within the department's artificial intelligence strategy.[55] As a result, there has been significant progress made in the past two decades with regards to near-real-time sharing of intelligence, surveillance, and reconnaissance information in digital form, as well as near-real-time sharing of "friendly" digital location data.

However, there has been relatively little progress in the near-real-time sharing of the more mundane information such as the current locations and inventories of ammunitions (both forward and in various depots), the availability of trucks and drivers to deliver that ammunition, the status of aircraft and pilots and their ability (e.g., qualifications) to fly various missions, or the availability of repair parts across the battlespace.

Conclusion

The XVIII Airborne Corps' use of MSS has demonstrated that a well-tailored AI-DSS tool in the hands of capable warfighters enables a team of 20 to do what in 2003 required 2,000. A natural question is, are there other applications where AI-DSS can help us achieve such gains? In this paper we explored the potential in two case studies, detailing how AI-DSS might support Army ammunition resupply tasks, or a much more ambitious effort to address elements of the Joint Air Targeting Cycle.

In both instances there are AI-DSS strengths that would bring specific operational benefits, but alongside those advantages, military and civilian leaders must also account for operational risks. These are highlighted in Table 4.

Table 4: Benefits and Risks of AI-DSS in Two Case Studies

Expected Benefits	Potential Risks
Improved situational awareness of friendly, enemy, and civilian objects	Diminished warfighter critical thinking (cognitive offloading)
Increased quality and completeness of a shared COP	Automation bias and the potential to incorrectly trust computer or AI suggestions over human intuition and experience
Increased decision speed and greater planning flexibility and responsiveness	Pressure to reduce the time needed or people required for complex judgements
Increased speed of information sharing, exchange, and analysis	Less time spent cross-checking information
Reduction in human errors in manual data transfer or re-entry	Data failures in either biased or incomplete training data or the data (i.e. sensors) available for decision-making

Decreased potential for loss of version control	AI failures (of which there are many, including narrow operational windows/fragility outside training data, state decay, context drift, hallucinations, and many more)

Applying AI-DSS to the JATC offers a real opportunity to revisit the existing doctrinal 72-hour timeline by addressing specific and known shortfalls in the current process. And while the risks to such an AI-DSS application are real, they can be limited and mitigated through careful engineering and human processes and oversight, and they must be weighed against the current risks inherent to the process as it exists today.

In examining these two case studies, we found several points in common with the XVIII Airborne Corps' experience applying MSS to land fires:

- The same foundational challenge: a voluminous amount of information that must be correlated, organized, and distilled before warfighters can effectively apply their expertise, experience, and judgment.
- Existing processes that rely primarily on humans to correlate, organize, and distill data using slow and error-prone processes built around Excel spreadsheets and PowerPoint slides.[*]
- Problems solvable by data science, data management, software, and scoped AI applications—not the creation of some massive, likely-to-hallucinate agentic LLM that "does it all".
- Challenge not in the creation of new AI capabilities, but rather in centrally collecting, correlating, and organizing the military's own data that is currently scattered across many units and maintained locally in spreadsheets, notebooks, technical manuals, or individual's minds—and doing so continuously in near-real time.

[*]At practically every military command we visited or spoke with, invariably one or more warfighters would allude in jest that "Microsoft Office is the primary weapon system powering our targeting and decision-making process."

The immediate challenge is digitizing this data and integrating it into the knowledge bases of the AI-DSS tools described in this paper. Top-level departmental support for data-sharing initiatives has never been stronger, and all parts of the department, under the leadership of CDAO, should exploit the Secretary and Deputy Secretary's support to break through bureaucratic, organizational, or cultural barriers.

The next step is to examine the best practices from the XVIII Airborne Corps and others pursuing similar AI-DSS initiatives and adopt or adapt them. In particular, the DevSecOps-style development approach combining operators, software engineers, and evaluators that the XVIII Airborne Corps used was key to rapid development and fielding of incrementally improving MSS-capabilities. It provides a template for other situations and contexts.

Drawing on the ongoing experience from MSS, the resulting AI-DSS tools and capabilities should be incrementally deployed to command centers during exercises and real-world operations. These provide opportunities to iteratively develop best practices and evolve military tactics, techniques, and procedures (TTPs). Commands will require resources to deploy AI-DSS responsibly and capture lessons learned, but the investment will accelerate the growth of experienced users that can effectively employ AI-DSS, as well as mentor and train others. Furthermore, establishing a development-deployment-feedback loop will help to refine existing AI-DSS tools and develop new ones in service of the warfighters.[56]

To facilitate this learning process, CDAO should lead the collection and promulgation of these lessons. CDAO should also resource support teams at the Combatant Commands to augment their AI-DSS efforts at the edge with personnel who have the necessary expertise and/or experience to bring to bear best practices acquired across the joint force.

These steps would position the military to employ AI-DSS in ways that would improve some of our most important Army and Joint fires-related processes and accelerate the responsible development and adoption of AI-enabled capabilities across the military.

Appendix A: Joint and Air Force Depictions of the Air Tasking Cycle

In describing the Joint Air Tasking Cycle (JATC), this paper follows the description and terminology that appears in Joint Publication (JP) 3-60 "Joint Targeting".[57] These Joint processes for the JATC, however, are based on processes developed by the Air Force, executed by the responsible Joint Force Air Component Commander (JFACC), and implemented in a corresponding Air Operations Center (AOC).

For this reason, and because Joint Publication 3-60 dates from 2018, we also examined the Air Force documents relevant to the Air Tasking Cycle. Two served as primary sources. The first is a dissertation, *Analyzing the Air Operations Center (AOC) Air Tasking Order (ATO) Process using Theory of Constraints*, written by three Air Force officers at the Air Force Institute of Technology (AFIT).[58] It contains a detailed analysis of how the AOC executes its processes and explores the choke points in those processes in a way that we have not found elsewhere. However, it is somewhat dated (2005) and is not an official Air Force document. So our second primary source is the official Air Force Manual on operating an AOC: AFMAN 13-1AOC.[59] Review of AFMAN 13-1AOC confirms that major elements described in the AFIT dissertation are still present and that the processes and timelines for the air task cycle execution from that dissertation remain about the same today. In addition to these documents, we also consulted a variety of other documents to supplement and/or confirm information.[60]

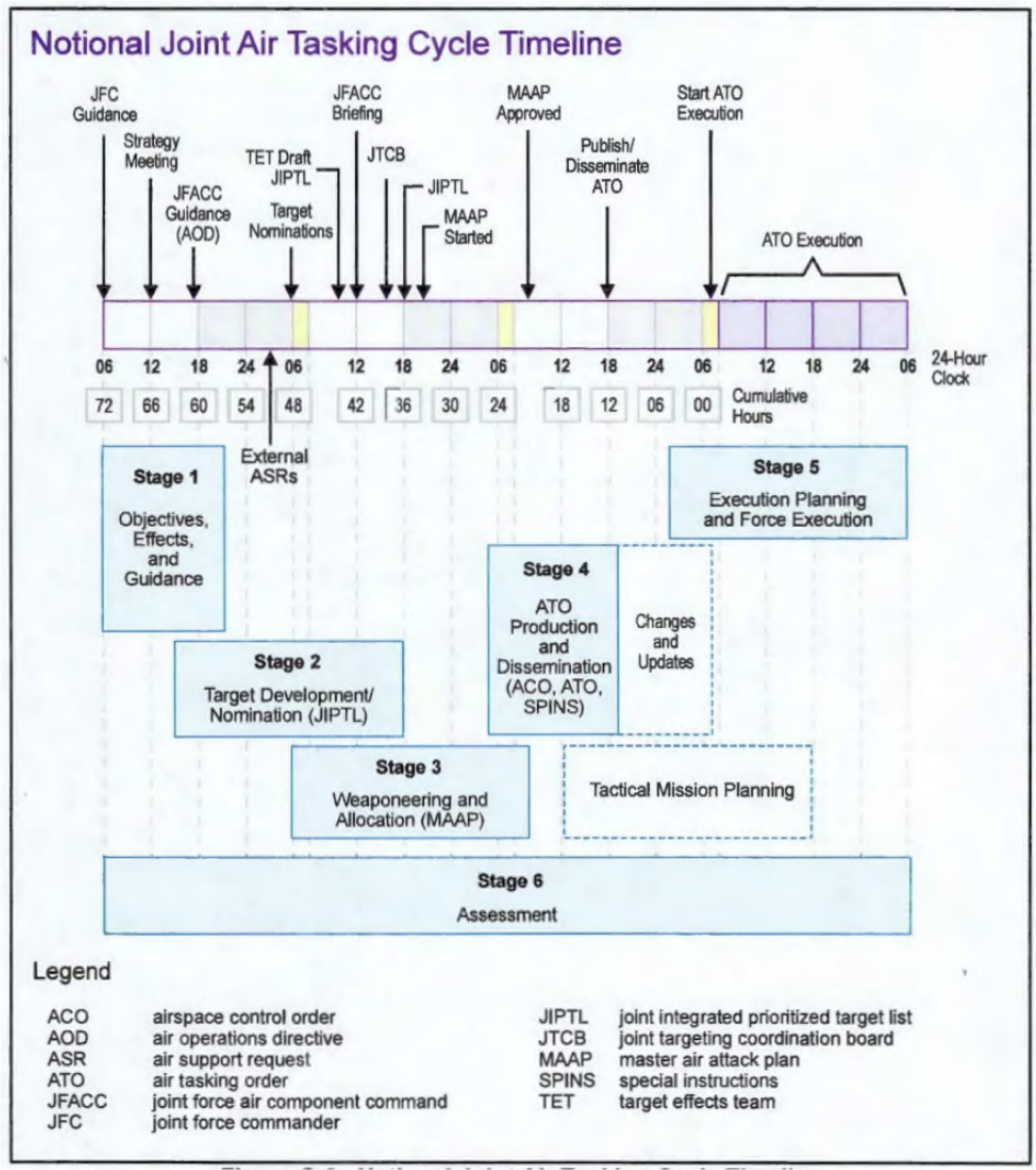
As expected, AFMAN 13-1AOC provides a more complete explanation of the JATC processes that sheds light on its many complexities and the details of how it is implemented. Nevertheless, AFMAN 13-1AOC reflects the same timeline and key events as JP 3-60. This can be illustrated by comparing the timeline charts from the two publications.

Figure A-1 below is the Notional Joint Air Tasking Cycle Timeline that appears in JP 3-60. It starts 72 hours prior to the execution of that cycle's Air Tasking Order (ATO), beginning with the issuing of the relevant Joint Force Commander's guidance. It identifies five sequential (but overlapping) stages in the process, and one continuous stage (Assessment). It identifies when in the cycle key documents are finalized:

- AOD at 60 hours prior to execution
- JIPTL at 36 hours prior to execution
- MAAP at about 24 hours prior to execution

- ATO at 12 hours prior to execution

Figure A-1. The Notional Joint Air Tasking Cycle Timeline

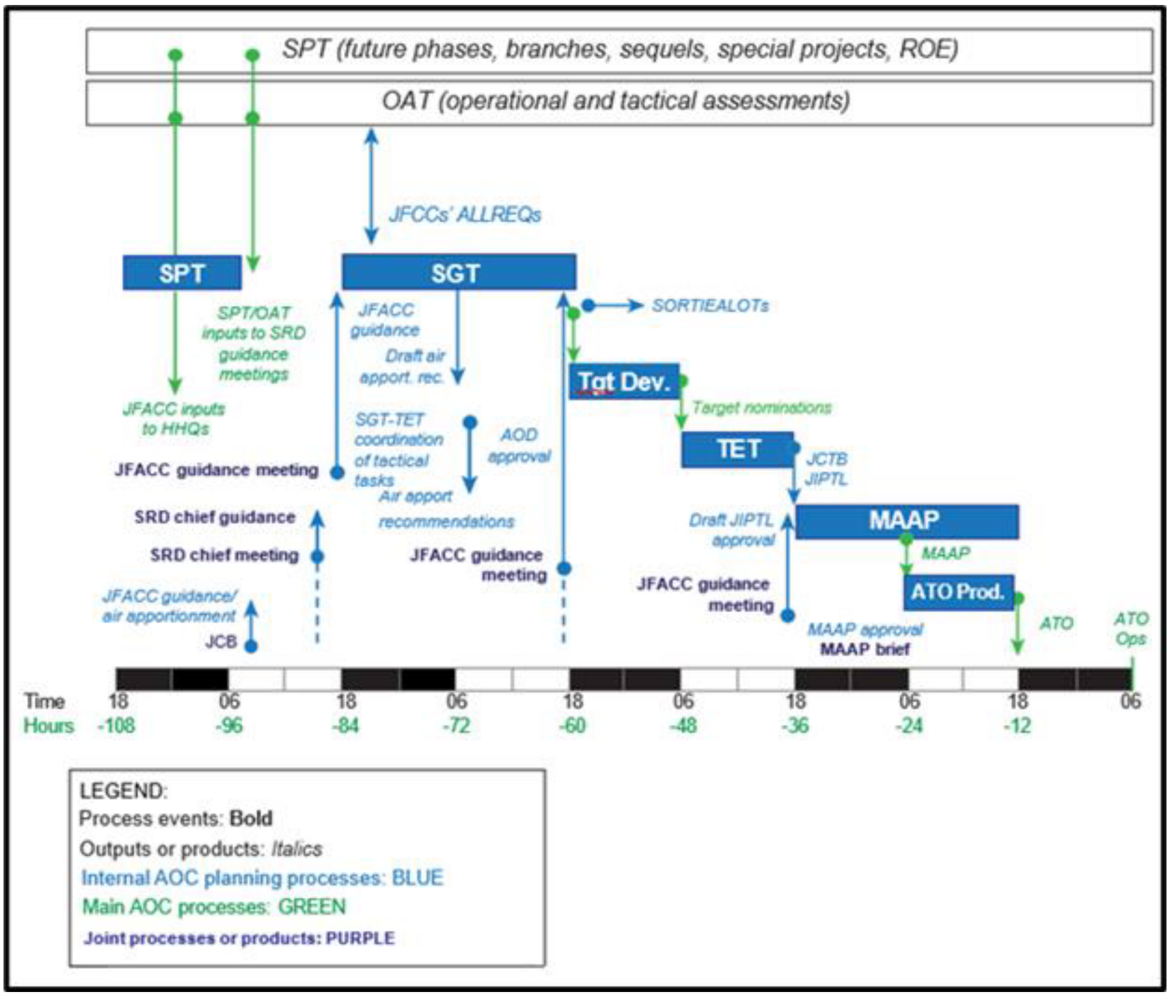


Source: Joint Publication 3-60, *Joint Targeting*, Fig. C-2, p. C-5.

Figure A-2 below is the corresponding diagram from AFMAN 13-1AOC, the Air Tasking Cycle Representative Timeline. Figure A-2 begins earlier than Figure A-1, starting 108 hours prior to the execution of that cycle's Air Tasking Order (ATO), but unlike Figure A-1, does not depict the 24-hour period of ATO execution. Figure A-2 does not identify "stages" that appear in Figure A-1, but instead identifies the AOC functional teams (highlighted with blue horizontal bars) that have lead responsibility for parts of the process:

- The Strategy Plans Team (SPT) and the Strategy Guidance Team (SGT) are part of the AOC's Strategy Division.
- The Target/Tactical Assessment Team is part of the AOC's Intelligence, Surveillance, and Reconnaissance Division.
- The Targeting Effects Team (TET), Master Air Attack Plan (MAAP) Team, and ATO Production Team are part of the AOC's Combat Plans Division.

Figure A-2. Air Tasking Cycle Representative Timeline



Source: Air Force Manual AFMAN 13-1AOC, Operational *Procedures—Air Operations Center (AOC)*, Figure 2-4, p20.

Note that the "stages" shown in Figure A-1 do not appear in Figure A-2, and they are not formal Air Force terminology regarding the Air Tasking Cycle. However, the text of AFMAN 13-1AOC does informally refer to various "phases" of the Air Tasking Cycle without explicitly identifying them as JP 3-60 does.

The period from 108 hours to 72 hours before ATO execution is not present in Figure A-1. Figure A-2 shows this period beginning with the SPT's review of relevant long-term plans (beyond 72 hours) and SGT's preparation of strategic guidance. At 72 hours prior to execution, the SGT issues the apportionment recommendations, at which point Figures A-1 and A-2 now overlap. The 72-hour point is the traditional "start" for the JATC.

From this point on until the beginning of ATO execution, the two figures align. Of note, Figure A-2 shows the key JATC documents finalized at the following times:

- AOD at 60 hours prior to execution
- JIPTL at 36 hours prior to execution
- MAAP at 24 hours prior to execution
- ATO at 12 hours prior to execution

These correspond to the same timeline depicted in Figure A-1.

Appendix B: Air Force Digital Tools Supporting the Air Tasking Cycle

The Air Force currently uses the Theater Battle Management Core System (TBMCS) to support the AOC personnel in executing the JATC and generate the MAAP, ATO, SPINS, ACO, etc. TBMCS was developed by Lockheed Martin in the late 1990s to replace an earlier system, the Contingency Theater Automated Planning System (CTAPS). TBMCS was initially fielded at the USCENTAF Coalition Air Operations Center (CAOC) in 2000–2001.

The Air Force has been exploring ways to evolve the TBMCS toolkit in several of the directions discussed in this paper.[61] While not an exhaustive list, the efforts we've identified in public literature include:

- Air Force Command and Control Air Operations Suite (ATOMS),[62] a set of tools developed and deployed in the early 2010s by Lockheed Martin to modernize several older TBMCS applications (e.g., the Theater Air Planner and the Master Air Attack Planning Toolkit) used to support Air Tasking Cycle processes.

- Kessel Run All Domain Operations Suite (KRADOS),[63] a modern, cloud-based software suite being developed by the U.S. Air Force's Kessel Run team to replace TBMCS and ATOMS and deployed at selected AOCs.

- Air Tasking Order Planning System (ATOPS),[64] a BAE Systems product that provides the capability to create daily air tasking orders (ATO) and associated airspace control orders (ACO), enabling military commanders and staff to better build an air attack plan.

- AOC-Anywhere,[65] a digital environment for the AOC that enables rapid integration of developmental models and applications with live data and operational applications.

- ARTIV,[66] an AI tool intended to speed up complex airlift planning for Air Mobility Command.

- Puckboard,[67] a tool used for crew scheduling.

- Intelligent Pairing Assistant (IPA) software,[68] a tool for pairing intelligence collection requests with intelligence, surveillance, and reconnaissance (ISR) capabilities to support schedule planning.

To the best of our knowledge, KRADOS is integrated into actual Air Force AOCs with real-time/near-real-time data inputs and outputs, but the others it seems are not.

These digital tools the Air Force is pursuing for the AOC of tomorrow are broadly aligned with the kinds of capabilities discussed in this paper and could well serve as stepping stones towards an AI-DSS to support the JATC process and AOC operations.

Appendix C: Commercial Sector Delivery Scheduling

In the last 30 years, companies such as FedEx, UPS, DHL, and Amazon revolutionized delivery through the use of advanced software, data management, and algorithms. Together, these tools enabled the real-time scheduling, delivery, monitoring, and replanning of packages worldwide. They execute delivery of a myriad of packages (ranging in size from individual nuts and bolts to industrial machinery and heavy freight) to many hundreds of thousands of customers located across the globe, using various combinations of delivery means (including long- and short-haul aircraft, trucks of all sizes, and even mopeds and drones).[69]

They accomplish this by employing two closely coupled tools. The first is the use of advanced software tools to collect and integrate all the relevant information about their operations in real time into a consolidated knowledge base. The second is the deployment of modern algorithms (including selected AI algorithms) that allocate package deliveries to available and suitable resources, schedule them, monitor execution continuously, and manage changes in near-real time.

The integrated knowledge base these companies maintain includes the status of all the packages they need to deliver, of all the warehouses and their contents, of all the delivery vehicles (whether operational or in maintenance), and even of all the human involved in the operation (vehicle operators, vehicle maintainers, warehouse staff, package handlers, etc.).

In our daily lives, we have all experienced the overall effectiveness and agility—and occasional hiccups—of their delivery processes. How exactly they operationalize the information, including the details of their algorithms, are closely held proprietary secrets. But we get a broad sense of these tools not only from private discussion with individuals who work or have worked in this sector, but also from academic research on delivery scheduling algorithms,[70] trade journal articles,[71] and documents released by the companies themselves, or companies that have partnered with them to develop these tools.[72]

Appendix D: Acronyms

This paper includes many acronyms due to its detailed discussion of certain military processes. All the acronyms essential to understand the discussion are defined at initial use. However, readers may find it hard to locate the first use of an acronym. Furthermore, the various figures copied from military documents introduce many other acronyms that are neither mentioned nor directly relevant to this paper. For ease of reference and completeness, all these acronyms are spelled out here.

ABP	Air Battle Plan
ACO	Airspace Control Order
AFATDS	Advanced Field Artillery Tactical Data System
AFIT	Air Force Institute of Technology
AFMAN	Air Force Manual
AI-DSS	AI-Enabled Decision Support System
ALLOREQ	Allocation Request
AOC	Air Operations Center
AOD	Air Operations Directive
ASR	Air Support Request
ATO	Air Tasking Order
ATOMS	Air Tasking Order Management System
ATOPS	Air Tasking Order Planning System
BDA	Battle Damage Assessment
C2	Command and Control

CAOC	Coalition Air Operations Center
CDAO	Chief Digital and Artificial Intelligence Office
CDE	Collateral Damage Estimation
CSAR	Combat Search and Rescue
CTAPS	Contingency Theater Automated Planning System
DEVSECOPS	Development, Security, and Operations
DIU	Defense Innovation Unit
ELINT	Electronic Intelligence
EW	Electronic Warfare
FRAGO	Fragmentary Order
GIG	Global Information Grid
GPS	Global Positioning System
ISR	Intelligence, Surveillance, and Reconnaissance
JAOP	Joint Air Operations Plan
JATC	Joint Air Tasking Cycle
JFACC	Joint Force Air Component Commander
JFC	Joint Force Commander
JIPTL	Joint Integrated Prioritized Target List
JTCB	Joint Targeting Coordination Board
KRADOS	Kessel Run All Domain Operations Suite

LLM	Large Language Model
LOGREQ	Logistics Requisition
LOGSTAT	Logistics Statistics (report)
MAAP	Master Air Attack Plan
MISREP	Mission Report
MLNPS	Military Logistics Network Planning System
MSS	Maven Smart System (an AI-DSS)
NGA	National Geospatial-Intelligence Agency
NSL	No-Strike List
OAT	Operational and Tactical Assessments
OIF	Operation Iraqi Freedom
QDR	Quadrennial Defense Review
ROE	Rules Of Engagement
SGT	Strategy Guidance Team
SORTIEALOT	Sortie Allotment
SPINS	Special Instructions
SPT	Strategy Plans Team
SRD	Strategy Division
TBMCS	Theater Battle Management Core System
TET	Target Effects Team

TLAM	Tomahawk Land Attack Missile
TTWCS	Tactical Tomahawk Weapons Control System
USMTF	United States Message Text Formatting

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