

# Joint Readiness Command and Control

Improving Warfighter Readiness  
with Artificial Intelligence and  
Machine Learning

## INTRODUCTION

Today's warfighters live in an increasingly complex world where a variety of military leaders across government and national security must be ready to respond to any crisis. As we head deeper into a new era of technological opportunity amidst growing tensions between great powers, national security leaders are expected to ensure our nation's ability to act when needed in the most effective and efficient manner possible.

## DEFINING READINESS

According to The Fundamentals of Military Readiness<sup>1</sup> report published in October 2020 by the Congressional Research Service, "the Department of Defense (DoD) requests and Congress authorizes and appropriates billions of dollars in Operations and Maintenance (O&M) funding to support what the DoD calls readiness." For reference, of the DoD's total budget request for 2021, \$290 billion is for O&M<sup>2</sup> to support readiness and other initiatives. Readiness has been defined in many ways, but the most common definition derives from the DoD's internal doctrine: "The ability of military forces to fight and meet the demands of assigned missions." Further, the DoD defines operational readiness as "The capability of a unit/formation, ship, weapon system, or equipment to perform the missions or functions for which it is organized and designed."

While the requirements of what goes into "being ready" vary across domains based on priorities and global commitments, the common theme revolves around enabling personnel to execute the mission with the necessary tools and assets at the right place and time. When readiness falters, the risks posed to the nation increases.

## THE CURRENT STATE OF READINESS

Readiness is far-reaching and stretches across areas like maintenance, supply chain and logistics, distribution, and beyond. However, in its current state, the coordination between government services, operational military

units, operating agencies of the DoD, and other federal government organizations to ensure readiness is complex, dynamic, expensive, time-intensive, and inefficient.

In 2018, a six-month investigation conducted by the Military Times<sup>3</sup> found that accidents involving all of the military's manned fighter, bomber, helicopter, and cargo warplanes rose nearly 40% from fiscal years 2013 to 2017. The rise can be attributed to reduced retention rates of experienced maintenance personnel, the lack of adequate training for less experienced maintainers, and cuts to flight-training hours, among other reasons. Further, a recent GAO report<sup>4</sup> found that 75% of planned maintenance periods were completed late for aircraft carriers and submarines from fiscal years 2015 to 2019, with an average delay of 113 days for carriers and 225 days for submarines. This translated to only eight of 18 aircraft carrier maintenance cycles completed on time and only five of 33 submarine maintenance cycles completed on time.

Similarly, another GAO report<sup>5</sup> focused on aircraft readiness found that of the 46 individual fixed and rotary wing types of aircraft assessed, only three met the service-established mission capable goal in the majority of the years during fiscal years 2011-2019. Even more surprising, 24 did not meet their goals for any year during the same time frame. Furthermore, for fiscal year 2019, over 40% of aircraft were more than 15 percentage points below the readiness goal. Program officials reported that aging aircraft, maintenance challenges, and supply support issues were responsible for the overall decline in mission capable rates.

Following these events, there have been multiple debates on whether there is a readiness crisis. Regardless of whether there's an actual "crisis," the need to improve readiness remains so that personnel can successfully execute their missions every time. Although many factors determine success on the battlefield, history clearly shows that forces displaying high levels of readiness are more likely to be successful. Thus, enhanced readiness is critical to defending the nation.

## KEY TAKEAWAYS

The DoD faces a growing issue with ensuring warfighter readiness across a diverse set of missions

The focus for AI solutions to date have been primarily placed on concepts like JADC2 while assuming readiness on the day of battle is provided

JRC2 is a family of AI-enabled solutions developed to solve the readiness challenge

JRC2 is powered by a data layer, an AI layer, and a solutions layer including SGS's Digital Maintenance Advisor product

JRC2 has the potential to scale and transform the way the DoD delivers readiness

## WHAT HAS BEEN DONE TO ENHANCE READINESS?

Efforts to utilize new technology, tools, and processes to enhance readiness have yielded minimal results in improving desired outcomes. This challenge becomes further complicated due to the expansive nature of organizational touchpoints and handoffs that the readiness value chain impacts. In order to improve readiness across all services and domains of the DoD, national security leaders must leverage modern technology, like artificial intelligence, that augments human capabilities, enhances the intelligence and awareness of personnel and continuously learns from large volumes of data to enhance decision-making.

In recognizing the changing technology landscape and the need to adapt to future warfare and technology, the DoD introduced a new initiative that aims to revitalize the military's current command and control infrastructure, which currently uses separate segments of the battle space between services and domains rather than a more centralized command approach. Known as Joint All-Domain Command and Control (JADC2), the concept is looking to establish a combined network of sensors across critical assets and warfighters that enable collective, real-time decision-making across various mission domains. A Congressional Research Service report<sup>6</sup> states that JADC2 enables the ability to make better, faster, and more informed decisions on the day of battle based on critical, all-domain mission data.

As of today, the DoD has held at least two major JADC2 exercises, both of which took place in simulated environments to counter potential threats. The first exercise was the first demonstration of the Advanced Battle Management System, the network designed to provide data across all domains to enhance decision-making and provide a fuller picture of the current operating environment. In theory, these two exercises demonstrate JADC2 as a better way of linking sensors and shooters for superior battle management on the day of battle. Both exercises assume operators had everything, including adequate levels of personnel, assets, and supplies, to meet the needs of the mission during the battle. However, the assumption that personnel have everything they need to fight on the day of battle is a strategic presumption that unless corrected will compound the readiness problem.

Thus, a new question must be answered: What can government agencies, national security organizations, and military forces across domains and services do to improve readiness before the battle rather than during, reducing the heavy burden on national security professionals to make key decisions on demand?

For context, the DoD has an estimated current force mix of ~3,200,000 personnel, ~14,000 aircraft, ~400 ships, ~400 satellites, ~5,000 missile systems, and ~225,000 land vehicles, each representing a node that generates an abundance of its own unique data. This vast collection of nodes spanning people, weapon systems, and platforms creates a wealth of opportunities to enable greater insights and mission readiness across services and domains. A connected, comprehensive approach can help this current force mix make better decisions to save time, resources, and enhance personnel performance across the board—ultimately improving readiness.

A new concept with predictive and prescriptive capabilities that can impact warfighter readiness has emerged. Leveraging proven, leading-edge commercial technologies, warfighters across services and domains will be ready when needed to successfully execute missions.

# GAO Report<sup>5</sup> on Aircraft Mission Capable Rates

## FY 2011–2019:

Only 3 of 46 assessed aircraft met mission capable goals in the majority of the years

## FY 2011–2019:

24 aircraft did not meet their goals for any year during this time frame

## FY 2019:

Over 40% of aircraft were more than 15 percentage points below the readiness goal



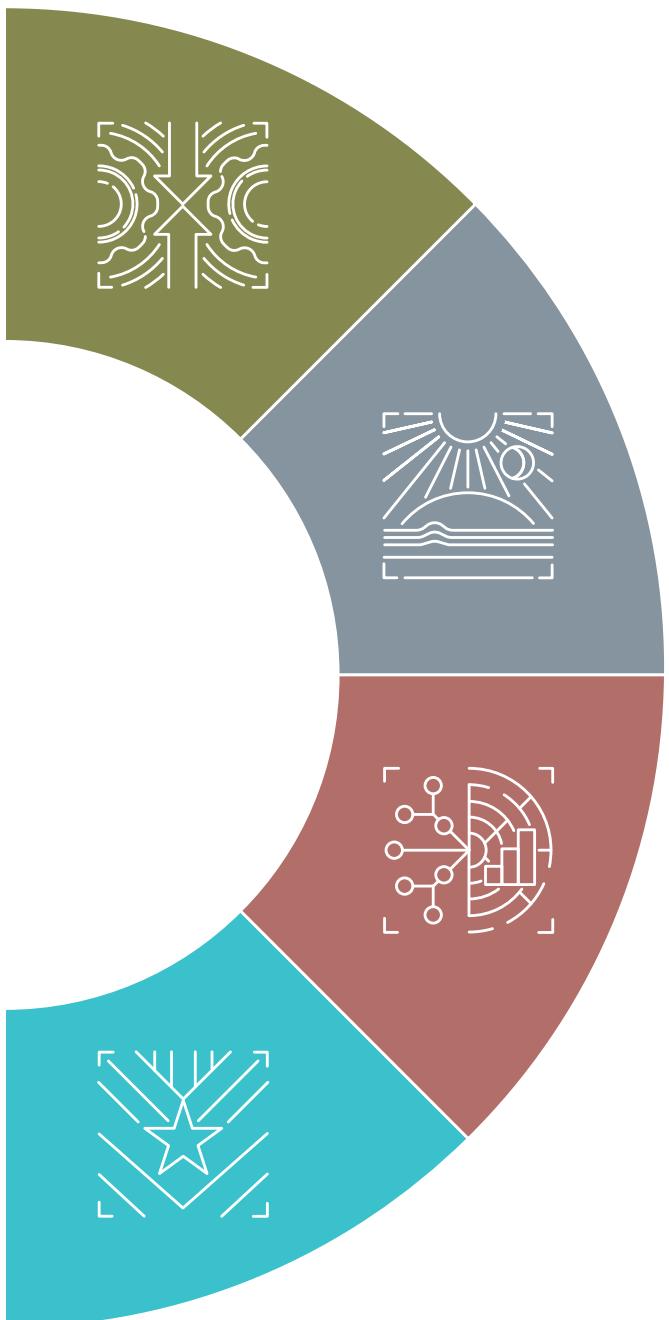
## JOINT READINESS COMMAND & CONTROL (JRC2)

To enable enhanced awareness and mission execution as well as continuous improvement of warfighter readiness, there needs to be a smarter, more connected view into the assets, resources, and broader logistics enterprise to create a holistic operating picture for leaders tasked with ensuring operational readiness.

Developed by SparkCognition Government Systems (SGS), JRC2 advances the science of defense by enabling and enhancing future missions. Like JADC2, the JRC2 solution offers a connected environment where

forces utilize transformative technologies like IoT sensors and artificial intelligence to successfully execute missions. However, while JADC2 focuses on battle management on the day of battle, JRC2 ensures that warfighters stay ahead of the continually evolving situation by utilizing artificial intelligence to enhance decision-making before the battle. Further, JRC2 can support both structured and unstructured data (i.e., documents, records, communications, etc.) to help make decisions and improve readiness, opening up the aperture for a wider range of usable data from various sources. The JRC2 solution contains, but is not limited to, four key elements:

# JOINT READINESS COMMAND & CONTROL (JRC2)



## MARKETS/CAPABILITIES

**Markets:** Maintenance, Repair & Overhaul, Supply Chain Management & Logistics, Distribution, Training, Mission Planning, Readiness (integration of other elements, including personnel)

**Capabilities:** Asset Visibility, Scenario Planning, Mission Risk Assessment, Supply Chain, Real-time Re-planning, SC Risk ID, Demand Planning, Inventory Management, Maintenance, Issue ID, Predictive Diagnostics, Prescriptive Mix

## DOMAINS/ASSETS

**Space:** Satellites, International Space Station, Missile Defense, Launch Systems, Spacecraft

**Air:** Fixed Wing, Fighters, Cargo, Patrol, Lavs, Rotor craft, Transport, Attack, Utility

**Land:** Tanks, Armored Personnel Carrier, Light Armored Vehicles, Logistics, Unmanned Vehicles

**Sea:** A/C Carrier, Destroyer, Amphibious Assault, Patrol, GUV, US

**Cyber:** Networks, Cloud Compute, Cyber Payloads, Information Operations

## EXTERNAL INPUTS/DATA

Weather Data, Delivery Data, Geopolitical Data, Intelligence Data, Personnel Data, Procurement Data, Inventory Data, Supplier Info/Health, Part Lead Time, Criticality of Need, Real Time Mix Data, Fleet Data, Asset Performance Data

## SERVICES

United States Air Force, United States Space Force, United States Navy, United States Army, United States Coast Guard, Department of Defense Operating Agencies, Foreign Military Allies and Alliances (i.e. NATO)

## WHAT VALUE DOES JRC2 PROVIDE FOR NATIONAL SECURITY LEADERS?

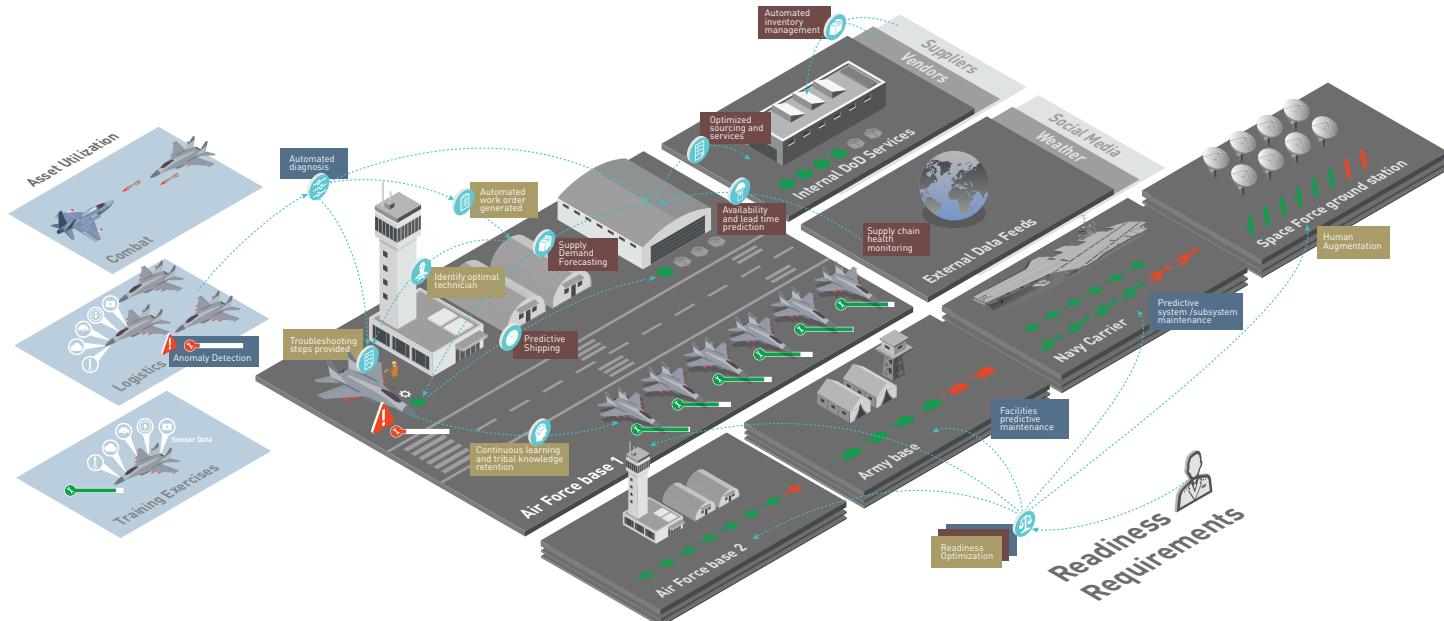
From maintainers to demand and operational planners to buyers and suppliers, JRC2 offers unprecedented speed, flexibility, accuracy, efficiency, and awareness.

- Speed: The importance of enabling enhanced decision-making in a timely fashion creates the ability to deliver greater readiness to the warfighter. This is delivered through predictive and prescriptive solutions that enhance all aspects of readiness from identifying and mitigating stockout situations to enabling unit and asset health monitoring.
- Flexibility: Creating supply chains that can adapt to dynamic environments is essential in the readiness mission. Through real-time planning and monitoring, the entire readiness value chain can respond proactively to anomalies and consistently achieve desired outcomes and resiliency.
- Accuracy: Increasing data flow --and collaboration between systems and services creates more detailed and accurate forecasting and decision-making. Further, continuous learning of algorithms creates greater predictive capabilities—creating more effective, collaborative planning.

- Efficiency: Bringing increased knowledge and insight into the decision-making process creates an opportunity to enable more effective use of assets and fleets. In addition, this reduces the heavy burden on DoD professionals who are tasked with making key decisions on demand planning, maintenance tasks, training, and other areas.
- Awareness: By creating better insights and views into the broader asset, unit, and mission needs, there is greater awareness and ability to see deeper into the value chain and supply base to understand supply chain risk and enhance collaboration.

## JRC2 USE CASES

The JRC2 solution can be applied across a wide range of use cases, all of which are essential to enabling warfighter readiness. Individually, these use cases have the potential to create value for the warfighter, but in combination and collaboration can create a significant impact in the way warfighters plan, monitor, connect, and deliver readiness based on insights. JRC2 not only can make an impact on specific actions and tactical areas, but also provide strategic considerations for leaders to make better decisions by leveraging both structured and unstructured data types. These use cases can be broken down into the three key focus areas shown below:



ASSET INTELLIGENCE	FORCE MULTIPLIER	DECISION OPTIMIZATION
Military assets and facilities comprised of multiple systems and components are difficult to monitor and understand. Utilizing multiple real-time and historical data streams enables patterns of normal behavior or event clusters of behavior to emerge, providing future predictions on asset performance.	The warfighter is faced with complex, dynamic roles that require multitasking in many environments. Utilizing historical and diverse data sets will enable greater focus on higher priority tasks and reduced cognitive load on the warfighter.	Both internal and external factors impact forecasting and planning efforts within the federal and national security market. Bringing together various data sets and optimizing around desired outcomes enhances efficiency and enables more effective decision-making.
<b>Use Cases/Applications</b> <ul style="list-style-type: none"> <li>• Asset Health Monitoring</li> <li>• Unit Health Monitoring</li> <li>• Predictive Maintenance</li> </ul>	<b>Use Cases/Applications</b> <ul style="list-style-type: none"> <li>• Prescriptive Maintenance</li> <li>• Real-Time Mission Planning</li> <li>• Anomaly Detection and Alerts</li> </ul>	<b>Use Cases/Applications</b> <ul style="list-style-type: none"> <li>• Real-Time Demand Forecasting</li> <li>• Predictive Shipping</li> <li>• Supply Chain Risk/Health Management</li> <li>• Predictive Inventory Management</li> </ul>

## USE CASE INTRODUCTION

While the concept continues to evolve, there are clear opportunities for JRC2 to support national security efforts and advance warfighter readiness. Since its inception, SGS has been working on solving the readiness problem with its AI solutions across a variety of real-world use cases, each of which offer a unique view into how JRC2 is positioned to work.

In one scenario, SGS leveraged its Digital Maintenance Advisor (DMA), a prescriptive maintenance and supply chain solution, to ensure asset readiness. The following section examines the use case as it relates to JRC2's four core elements:

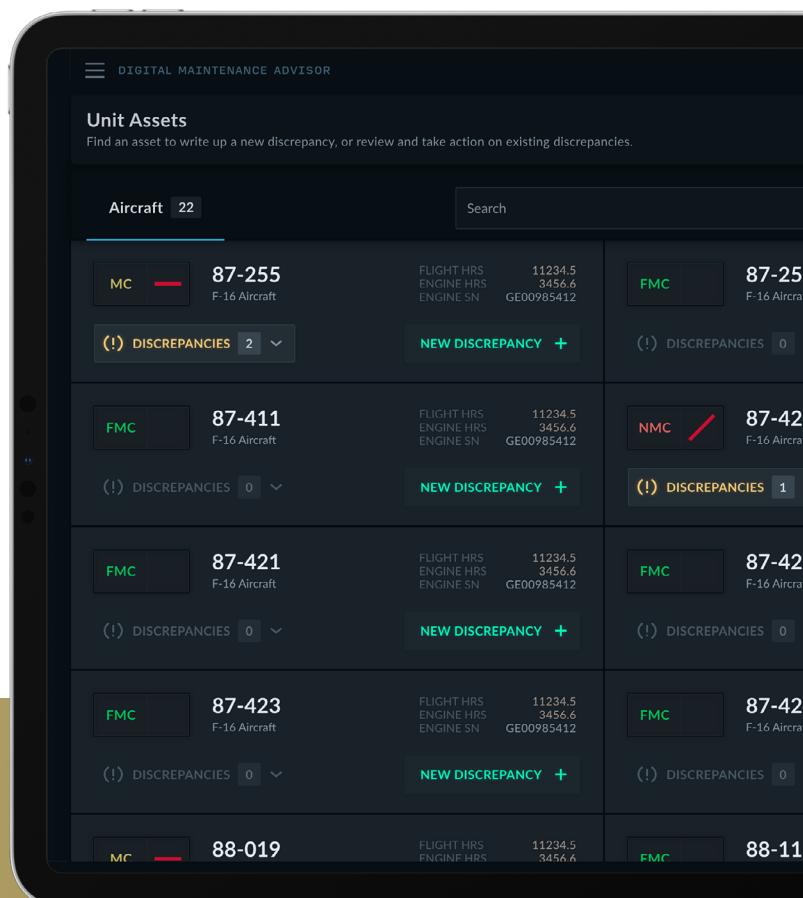
ELEMENTS	DESCRIPTION
Markets/Capabilities	DMA is expected to create significant value by enabling aircraft maintainers to reduce the time to diagnose and fix maintenance issues by 25% and increase aircraft availability by one additional sortie per day.
Domains	Warfighters must be ready to act across a multitude of missions. In this scenario, DMA ensures the capability of airmen to perform assigned flight missions in multirole fighter aircraft.
External Inputs/Data	Data at all levels, including unstructured data, are important to deliver the most effective solution. Artificial intelligence and natural language processing ingested and analyzed a range of inputs such as manuals, maintenance logs, parts availability data, and many other channels to enable rapid, data-driven decisions
Services	Warfighters spanning the United States Air Force, the National Guard, and other services benefit from aircraft availability at all times to ensure mission success.

### IN THIS USE CASE, DMA:

- Identified about 80,000 unnecessary part replacements
- Mined 115,000 work orders in three weeks, demonstrating the ability to scale rapidly
- Identified 70,000 work orders with verifiable resolutions to generate prescriptive recommendations
- Showed resets are required only 20% of the time, but are 80% effective in resolving work orders, reducing the use of expensive replacement parts or systems
- Overall reduced the time to diagnose and fix a maintenance issue by 25%, and increase aircraft availability by one additional sortie per day

The connected view across markets, domains, services, and data highlights the JRC2 concept's ability to deliver actionable insights back to leaders and maintainers. Additional nodes including other types of aircraft, ground systems, naval ships, and other assets create the potential for greater efficiency, better awareness of asset and fleet performance, enhanced decision-making, and overall increased readiness rates across the joint force. With current aircraft availability rates hovering at a current low of 62%, JRC2 could be instrumental in improving annual readiness goals.

Estimated to reduce the time to diagnose and fix a maintenance issue by 25%



## USE CASE INTRODUCTION

In another scenario, SGS leveraged its Digital Maintenance Advisor (DMA), an AI-enabled demand forecasting solution that helps personnel predict future demand and lead times and understand key risks that

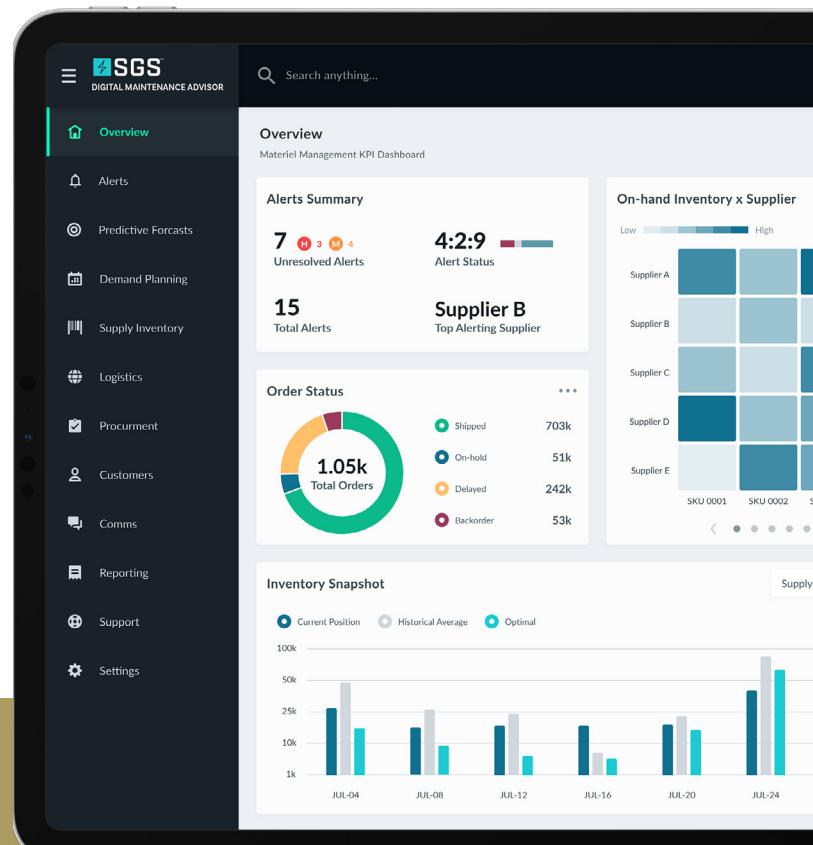
may disrupt the supply chain, enabling leaders to improve supply chain resiliency. The following section examines the case study as it relates to JRC2's four key elements:

ELEMENTS	DESCRIPTION
Markets/Capabilities	DMA created significant value by improving demand forecasting for a DoD logistics organization by analyzing and forecasting 48,000 individual items without risk of under-forecasting, ensuring warfighters have the critical commodities and supplies they need to achieve readiness targets. In addition, estimated annual savings from the deployment exceeded \$100 million.
Domains	Supply chain health can lead to a significant decline in readiness across all domains. DMA ensures space, air, land, and sea teams have the parts they need to target goals in their respective missions.
External Inputs/Data	Artificial intelligence analyzed real-time data from multiple sources including weather, shipping and routing information, supplier business information, and more for anomalies to create more accurate predictions of when issues may arise in the supply chain.
Services	All services benefit from a robust supply chain.

### IN THIS USE CASE, DMA:

- Generated estimated annual savings exceeding \$100 million
- Forecasted 48,000 individual items without risk of under-forecasting

Once again, this connected view highlights the JRC2 concept's ability to deliver actionable insights back to supply chain leaders, effectively enhancing the decision-making process to ensure a healthy supply chain that supports mission readiness. Additional nodes including different parts, lead times, and external factors such as weather and supplier health will only strengthen JRC2's impact on readiness levels. For example, JRC2 may be useful in identifying troubled suppliers, preventing part obsolescence issues, and more to help prevent costly supply chain disruptions.



Generated estimated annual savings exceeding \$100 million

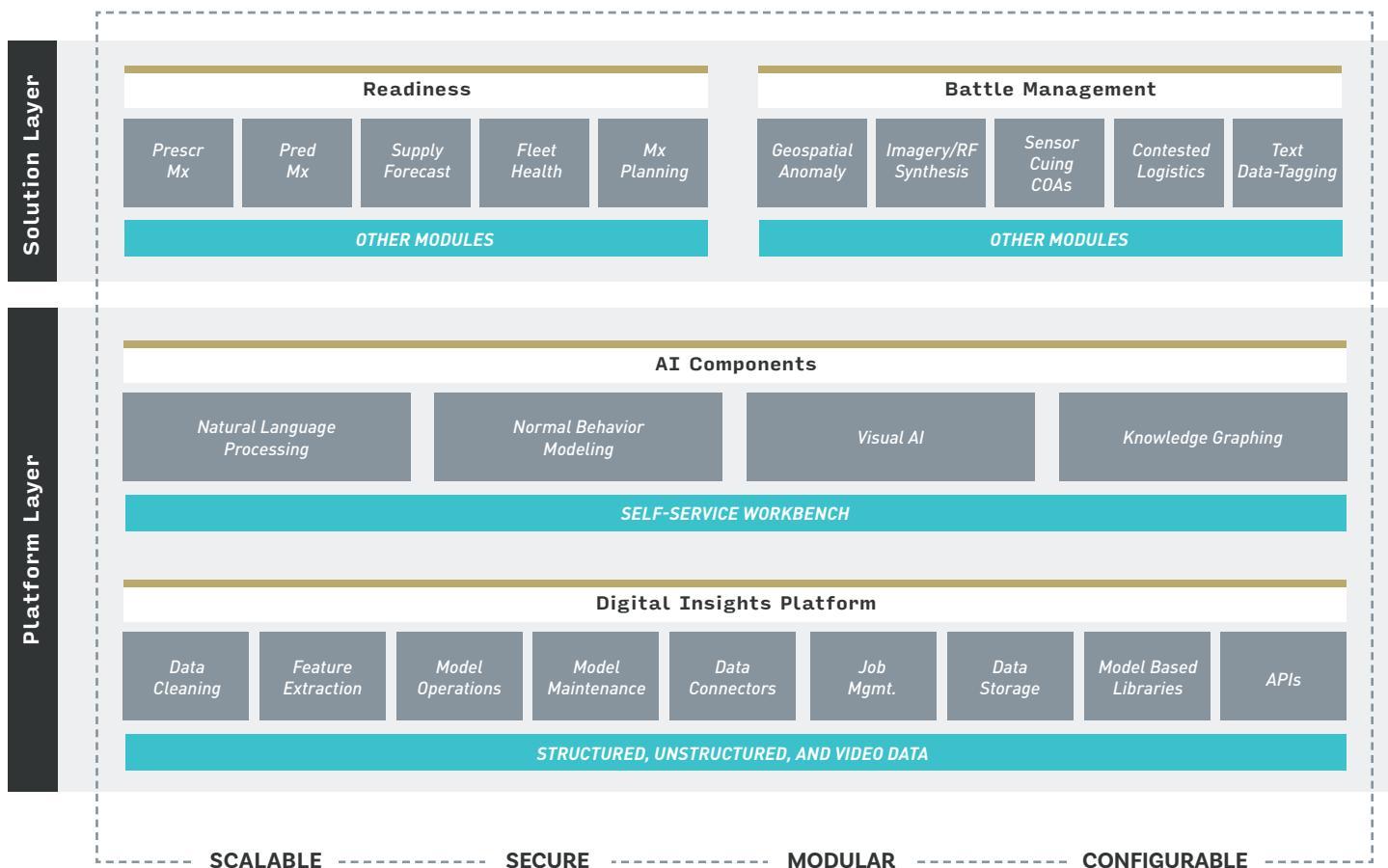
Ultimately, connecting maintenance and supply creates compounding effects within the readiness platform. By linking the data layer, AI layer, and solutions layer DMA can be tailored to the customer's needs to achieve full readiness value. For example, when personnel need to improve decision-making on critical maintenance efforts, each layer across the chain plays a critical role in assisting them to supply the necessary parts for those maintenance tasks. By continuing to feed critical information back and forth across the value chain, JRC2 is better able to strengthen warfighter readiness, capability, and resilience.

While SGS is already making an impact today with DMA, the above case studies offer a glimpse into how JRC2 works, how it can scale over time, and how it has the potential to transform the way the DoD enhances

readiness. As we head deeper into this new era of technology, JRC2 has the opportunity to shape AI into the impenetrable armor that will protect our nation and our allies in the 21st century.

SGS is looking to connect with national security leaders, technology experts, government agencies, and key decision-makers who share this vision to enhance readiness and help build the JRC2 growth roadmap. By merging our efforts, we will further improve how to define, measure, and produce the desired levels of readiness in the changing face of warfare. For more information on how JRC2 can enhance warfighter readiness, please contact us at [info@sparkgov.ai](mailto:info@sparkgov.ai).

## SGS READINESS PLATFORM



## REFERENCES

- <sup>1</sup> Congressional Research Service. *The Fundamentals of Military Readiness*. <https://fas.org/sgp/crs/natsec/R46559.pdf>
- <sup>2</sup> Congressional Budget Office. *Long-Term Implications of the 2021 Future Years Defense Program*. <https://www.cbo.gov/publication/56554#>
- <sup>3</sup> Military Times. *The Death Toll for Rising Aviation Accidents*. <https://www.militarytimes.com/news/your-military/2018/04/08/the-death-toll-for-rising-aviation-accidents-133-troops-killed-in-five-years/>
- <sup>4</sup> GAO Report. *Navy Shipyards: Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines*. <https://www.gao.gov/products/gao-20-588>
- <sup>5</sup> GAO Report. *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely*. <https://www.gao.gov/assets/gao-21-101sp.pdf>
- <sup>6</sup> Congressional Research Service. *Joint All-Domain Command and Control (JADC2)*. <https://fas.org/sgp/crs/natsec/JF11493.pdf>
- <sup>7</sup> Emerald Insight. *Providing a Piece of the Puzzle: Insights Into the Aircraft Availability Conundrum*. <https://www.emerald.com/insight/content/doi/10.1108/JDAL-09-2018-0015/full.html>

## SPARKCOGNITION GOVERNMENT SYSTEMS

SparkCognition Government Systems' (SGS) award-winning AI solutions solve the most critical challenges for government, national security, and defense. Using its patented AI, machine learning, and natural language technologies, SGS analyzes complex and diverse data in real time to inform and accelerate decision making, predict future outcomes, prescribe next-best actions, and augment human intelligence. We partner with organizations to ensure mission readiness, national security, and operational excellence. For in-depth information about SGS and its offerings, visit [www.sparkgov.ai](http://www.sparkgov.ai).