

**Government  
Business  
Council**

# **Averting Catastrophe**

Predictive Maintenance in the U.S. Military

**CLOUDERA**

## THE BIG PICTURE

Any tool that has a lifespan will eventually need maintenance, and the U.S. military knows this better than most. However, many service branches, faced with tight budgets, find it difficult to take proactive approaches to maintaining their equipment. Parts are instead replaced on a schedule or only when they're broken. This sometimes means that necessary service equipment (including ships, vehicles, and aircraft) aren't available when they're needed, or even malfunction at critical moments.

## WHY IT MATTERS

Service members need to know that their equipment will be ready to go whenever they need it. Tools that have broken or are not being maintained properly can, at best, lead to delays. At worst, they can dangerously malfunction. Military assets need to be consistently maintained not only to ensure readiness and maintain tactical advantages, but specifically to protect the military's most important asset — the service women and men who work alongside them.



## BY THE NUMBERS

+

The United States military has 40,000 armored vehicles, 13,000 aircraft, and nearly 500 ships.

\$

Estimated maintenance costs hover around \$71 billion annually.

70%

About 70% of a ship's lifecycle costs are operations and maintenance related.

7,424

Over a two year period, 7,424 days were spent waiting to repair Navy ships.

64

In 2020, the average delay for major maintenance on ships using a contractor approach was 64 days.<sup>1</sup>



## MAINTAINING READINESS

Equipment maintenance, repair, and overhaul (MRO) is a crucial component of ensuring military readiness and warfighting capacity. MRO typically accounts for more than 10% of total defense budgets, and over 70% of costs related to aircraft maintenance.<sup>2</sup> However, unexpected maintenance issues can significantly add to costs, moving budgets off track and delaying important overhauls. Without properly maintained equipment, military assets lose value, mission readiness is compromised, and there can be detrimental delays or even safety concerns for the asset and the crew.

Spotlight  
Navy  
Vessels

The Navy has recently dealt with a worrying deficit in ship maintenance. Between 2019 and 2020, the Navy faced a \$1 billion shortfall for ship depot maintenance, deferring necessary maintenance and delaying scheduled maintenance periods.<sup>3</sup> Littoral combat ships (LCS), for example, often face up to over two months of delays due to unexpected maintenance costs and high contractor fees.<sup>4</sup> In some cases, even very small unforeseen maintenance issues led to long periods of delay as shipyard workers waited for approval. "If we are looking where to improve upon it, each of these studies came to the same conclusion: the biggest inhibitor to fleet readiness is maintenance and modernization performance in the shipyards," said Fleet Forces Fleet Forces Commander Adm. Chris Grady at the September 2020 Fleet Maintenance and Modernization Symposium. "We simply must get better."<sup>5</sup>





# MAINTENANCE CHALLENGES



## **Efficiency**

Traditional preventative maintenance occurs when things break. This means that spare parts must be purchased and carried around, whether needed or not, and equipment in need of repair languishes in shipyards or hangars for months, waiting for a part to arrive or the maintenance crew to get to them. These timelines reduce availability and negatively impact mission readiness capacity.



## **Delays**

The high operational demands of the service branches mean that planning maintenance can be difficult. The full extent of needed repair is not often evident until maintenance crews get to work, where time spent waiting to fund and approve additional maintenance adds up to about 70% of “growth work.”<sup>6</sup> With only 65% of ship maintenance completed on time in 2020, fleet sustainment is negatively impacted by time spent waiting for assets to be mission ready.



## **Cost**

Budgets are always top of mind for the armed forces, and maintaining a ready fleet is expensive. Delays in maintenance, unexpected costs, or ships and planes that are more broken than they were supposed to be all drive up expenses, affecting budgets and making it more difficult to plan. A 2020 GAO report found that, for six shipbuilding programs alone, the Navy had underestimated sustainment costs by \$130 billion.<sup>7</sup>



## **Risk**

Poorly maintained assets can lead to equipment failure and risk to the asset. They also raise risk for the crew members. According to a December 2020 congressional report by the National Commission on Military Aviation Safety, 224 pilots and aircrew members have died since 2013 as a result of military aviation accidents, and nearly every service branch loses personnel every year.



# THE PREDICTIVE MAINTENANCE SOLUTION

Predictive maintenance offers solutions to some of these problems. Predictive maintenance leverages the power of data to proactively analyze and forecast when military assets will need to be fixed, long before they break. This data is pulled from a variety of sources, including performance and maintenance logs, inspection reports, historical notes on how similar systems have functioned, environmental data, and monitoring data. That data is aggregated and assessed for any anomalies or failure patterns, which are then used to make intelligent recommendations for best actions. This type of software has several specific advantages that are crucial for decision-makers.



## **Time**

- Analyzes all available data to determine the ideal time for maintenance for just before it's needed.
- Aligns with unscheduled maintenance work, to maximize asset availability.



## **Cost**

- Reduces need to stock spare parts for "just in case" situations.
- Dramatically improves forecasting for future budget requirements by giving decision-makers insight into when money will need to be spent so that they can budget accordingly. This cuts down both on emergency spending for unexpected failures, and time to get the asset back into service by pre-approving the maintenance.
- Improves negotiation power in service level agreements with part providers by understanding when an asset is likely to fail based on historical analysis or similar equipment in similar operating environments, what it will need, and the cost of those parts.



## **Safety**

- Anticipating when parts may fail before they do so is crucial to the safety of the asset and the service member operating them.
- While not a silver bullet, predictive maintenance allows operators to better identify and remediate potential areas of concern, before there is significant risk to the operating team.

**6.6**

MILLION

## **AIR FORCE KC-135 TANKER**

That's the total cost of a hydraulic pump failure of the Air Force KC-135 tanker. Over the course of several years, this one part failed over two dozen times, each time grounding the tanker for months at a time, preventing it from performing its mission and costing millions of dollars in taxpayer money.<sup>8</sup>



# CONDITION-BASED MAINTENANCE (CBM+)

To improve sustainment outcomes, the DOD has developed a joint readiness initiative focusing on combining data analytics and technological capabilities. The initiative is, at its core, “maintenance performed on evidence of need,”<sup>9</sup> based on principles of reliability and condition-based maintenance. Additionally, it is scaled up to include rich data analysis that allows accurate forecasting of maintenance requirements and future weapons system readiness. CBM+ is used in concert with other life cycle management tools to improve decision-making and support long-term DOD goals that support warfighter needs.



## Looking Forward

Most branches of the military are already embracing artificial intelligence, machine learning (ML) and predictive technologies as a part of their toolkit.

- **The Navy** has installed CBM+ systems on 94 of 177 surface ships, which uses 3,000 to 5,000 sensors per ship and utilizes Digital Twin technology to automate analysis and flag anomalies for review.<sup>10</sup>
- **The Air Force** is developing sensor based algorithms and monitoring systems for their aircraft.
- DOD's **Joint AI Center** (JAIC) is focusing on predictive maintenance programs for helicopters.<sup>11</sup>
- **The Army** uses AI analysis to predict vehicle breakdowns, including software in Bradley tanks that increases their availability and enhances readiness.



## CONCLUSION

Maintaining warfighting capabilities can come down to a few broken parts. These broken parts, however, can cost time, money, and even fatalities if not properly identified and addressed early on. Optimizing life cycle management is a priority for the defense community, to mitigate risk and ensure mission readiness at all times. Tools like predictive maintenance, which can align with unscheduled maintenance work, both maximizes asset availability and give insight into the time and cost needed for military assets, which assists with budgetary and safety concerns. As military decision-makers continue to look for ways to cut costs while keeping a war-ready force, tools like predictive maintenance can work to rapidly assess readiness, leverage data to support decision-making, and protect those who serve.





## CLOUDERA'S PERSPECTIVE

Using the force of data analytics to support predictive maintenance can be a powerful tool to support the safety and mission readiness of those in the Armed Forces. With CDP Private Cloud, it can be simple, too.

CDP Private Cloud is a next-generation, hybrid data platform with cloud-native, self-service analytic experiences bringing the speed, scale, and economics of the cloud. Unlike traditional big data stacks, CDP Private Cloud has highly scalable object storage, a secure and governed data lake with enterprise-wide data, is hybrid-cloud enabled with consistent management services, and runs on a computerized compute cloud. This means rapid deployment, 50% reduced data center costs, and 100% tenant isolation. Cloudera delivers end-to-end support for the entire platform, including regular health checks and embedded systematic support for your data.

Adopting modern platforms for data analytics is a crucial step in defense modernization, and predictive maintenance has the capacity to vastly improve the cost and safety of military assets. With CDP Private Cloud, let data inform the mission of defense.



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**CLOUDERA**

## **ABOUT CLOUDERA**

At Cloudera, we believe that data can make what is impossible today, possible tomorrow. We empower people to transform complex data into clear and actionable insights. Cloudera delivers an enterprise data cloud for any data, anywhere, from the Edge to AI. Powered by the relentless innovation of the open source community, Cloudera advances digital transformation for the world's largest enterprises.

Learn more at [Cloudera.com](http://Cloudera.com).



# ENDNOTES

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