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VIEWPOINT

DATA DRIVEN READINESS

USING ADVANCED ANALYTICS TO BALANCE PERFORMANCE WITH COSTS

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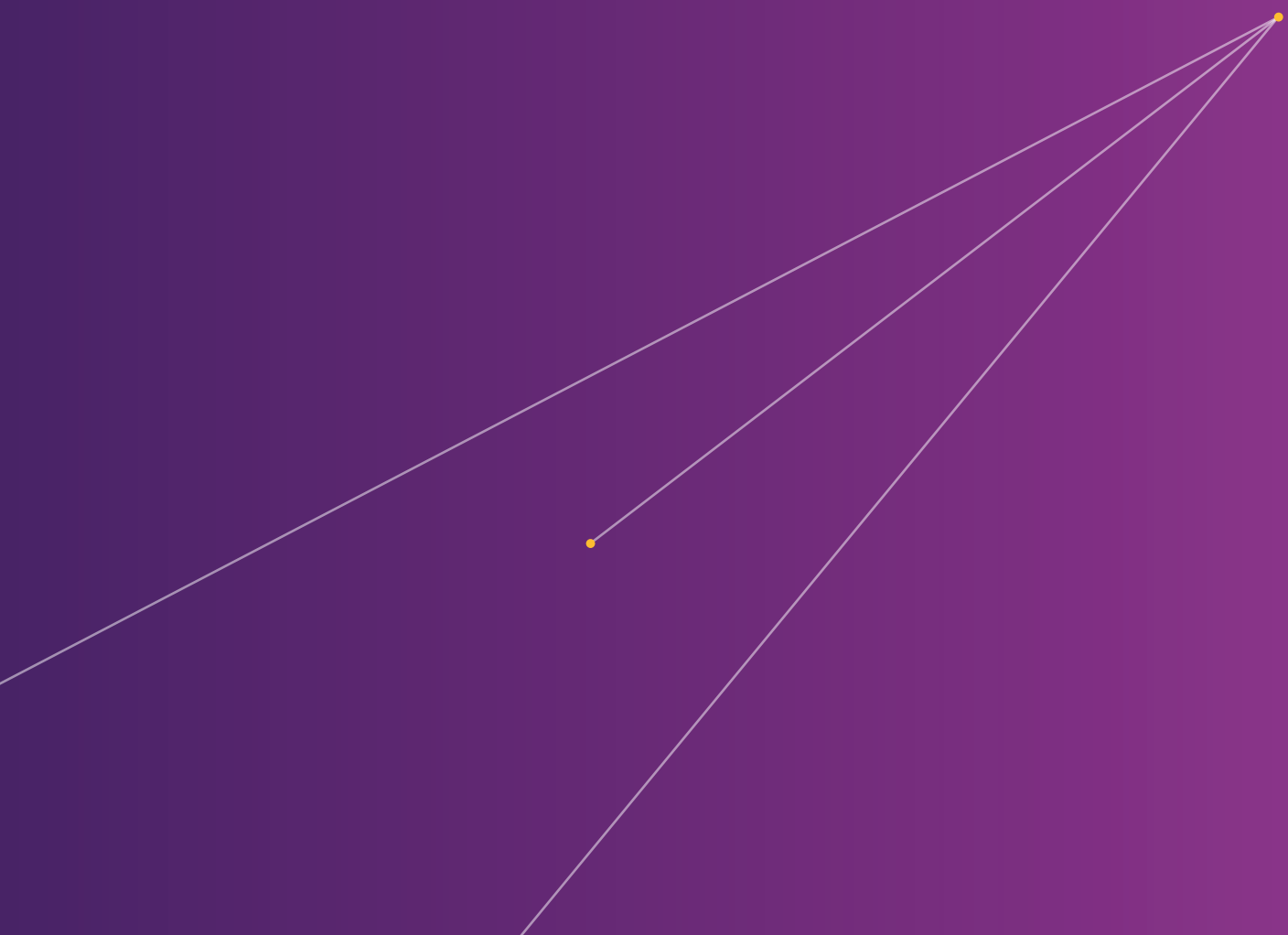


USING ADVANCED ANALYTICS TO BALANCE PERFORMANCE WITH COSTS

THE CHALLENGE: Balancing Performance With Costs In Military Readiness

After more than 15 years of operating on a wartime footing, the military services are struggling to meet readiness requirements in many critical areas. The Budget Control Act and sequestration, Continuing Resolutions, and insufficient defense budgets failed to provide the resources required to maintain readiness in response to global security demands and the tolls of high operating tempos on weapons systems maintenance and sustainment, personnel, and training. This led to the current readiness crisis, compounded by peer and near-peer adversaries closing the United States military's technological and numerical advantages and their increasingly more aggressive posturing. This leaves little room for error in readiness planning and resource allocation.

While using available data and both qualitative and quantitative information, military commanders also draw heavily upon their knowledge and experience to develop an intuitive understanding of the factors that go into allocating resources to achieve desired readiness levels in areas such as training, personnel and equipment. But no single person, or even a group of decision-makers, can fully consider the complex interrelationships of the hundreds, perhaps thousands of variables that may underlie a readiness investment decision.

Military commanders and their civilian counterparts need to tease out the complex tradeoffs in terms of both costs and benefits to optimize the Department's readiness. Allocating resources (e.g., personnel, equipment, and training) to meet objective, and often individually measured, readiness metrics may lead to sub-optimal results. In part, this is due to a limited ability to assess the marginal readiness achieved from resource decisions (dollars spent) as well as the potential second- and third-order effects. This assessment and the resulting resource expenditures must also consider the expected operational environment and threat.

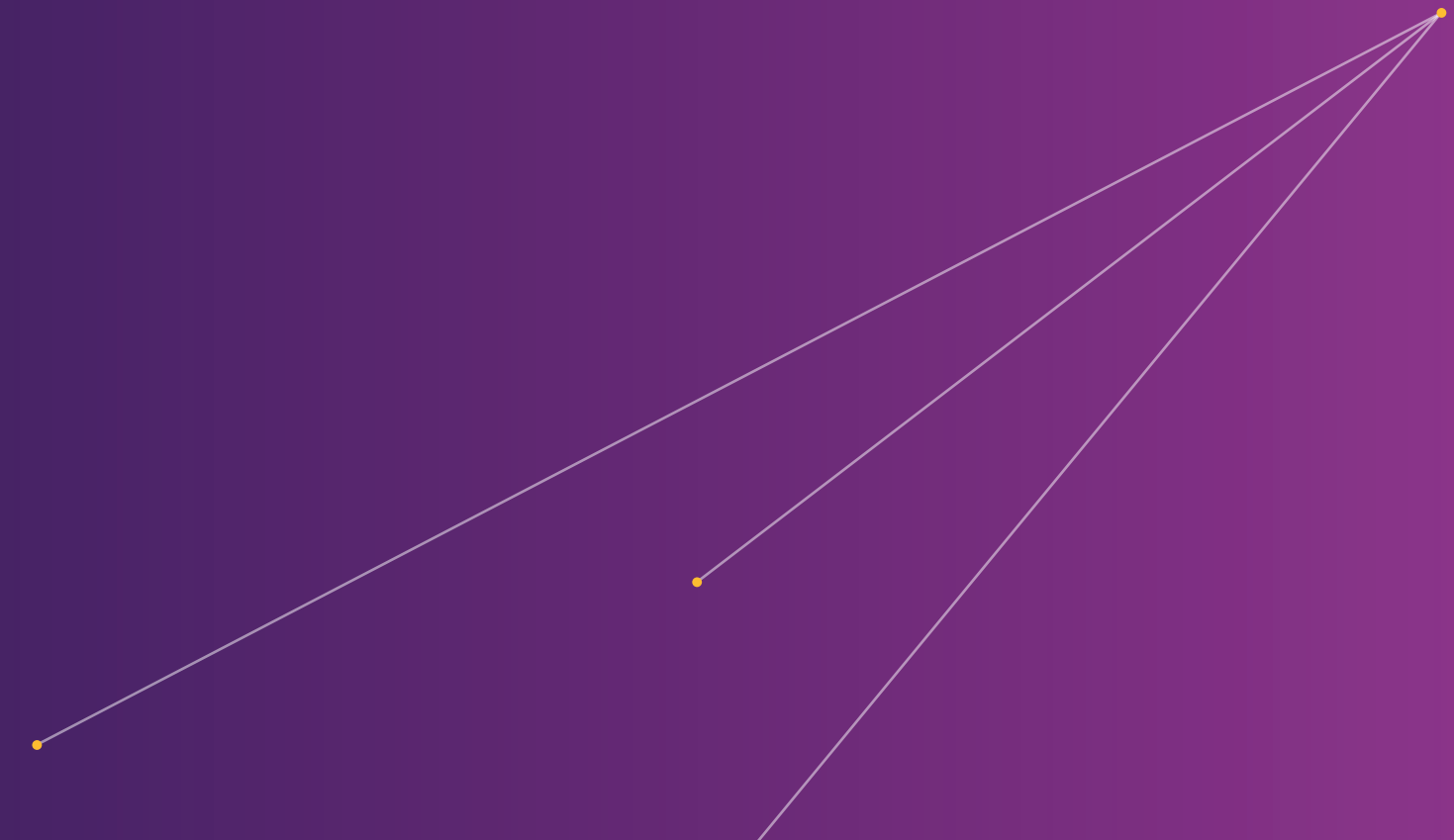
In addition to assessing the operational impacts of current readiness conditions, commanders also need to constantly and efficiently balance the available resources to maintain and improve readiness to meet near- and longer-term requirements. For example, a commander who can better

understand the costs and expected readiness gains associated with various training events, in a quantitative and comparative model, will be more informed and able to make difficult tradeoff decisions. This kind of fact-based assessment can not only lead to more effective use of resources, but also help justify budgets and make the case for funding.

The factors used by military leaders to determine readiness include qualitative and quantitative assessments ranging from commanders' reports to measures of personnel, training, equipment usage, maintenance cycles, supply chains, and other related factors. Readiness reporting systems across the Department of Defense collect current readiness inputs and near-term projections from military units with the goal of generating objective, accurate, and timely qualitative and quantitative readiness measures.

These systems contain a profusion of readiness-related data, but do not provide decision makers responsible for assessing composite readiness with a sufficient understanding of the complex inter-relationships among readiness variables or the tools for determining where to best spend the next "readiness dollar." Having a more sophisticated and accurate understanding of readiness resource costs, impacts, and tradeoffs will enable leaders to make more realistic readiness decisions, and do so in a cost-effective manner.

"A COMMANDER WHO CAN BETTER UNDERSTAND THE COSTS AND EXPECTED READINESS GAINS ASSOCIATED WITH VARIOUS TRAINING EVENTS, IN A QUANTITATIVE AND COMPARATIVE MODEL, WILL BE MORE INFORMED AND ABLE TO MAKE DIFFICULT TRADEOFF DECISIONS. THIS KIND OF FACT-BASED ASSESSMENT CAN NOT ONLY LEAD TO MORE EFFECTIVE USE OF RESOURCES, BUT ALSO HELP JUSTIFY BUDGETS AND MAKE THE CASE FOR FUNDING."



A NEW PERSPECTIVE: Capitalizing On The Full Value Of Readiness Data

Defense organizations have long sought to take full advantage of one of their most valuable resources – the vast amount of data they collect day in and day out. This data can support more insightful, forward-looking decisions about readiness, logistics, manpower, costs, and a host of other critical defense concerns. A new generation of advanced analytics – high-level diagnostic and predictive – can provide them that opportunity.

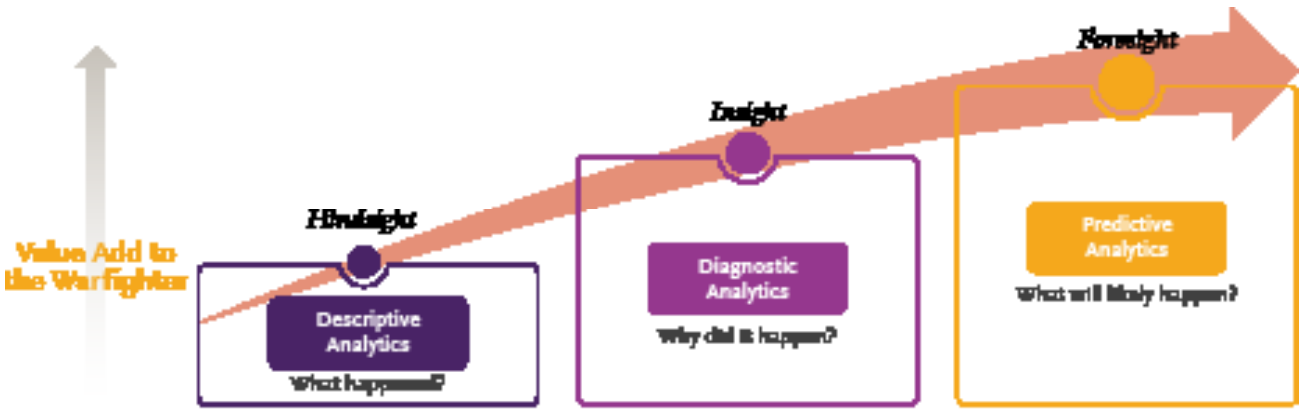
With advanced analytics, defense organizations can go beyond looking back at data to make projections. They can begin to drill deep into cause and effect, and determine the mathematical probability of future occurrences. This is the transition from hindsight to foresight.

The conventional approach to creating more objective, data-driven readiness systems has called for collecting more data and different types of data. Although it seems reasonable to believe that more data will generate more insight, this approach marches up the wrong path. The problem isn't lack of data or even lack of the right data. For the most part, the military services are already collecting the data needed for more robust analytic assessments of readiness. The problem is organizations are looking at data in isolated silos – such as training, personnel, equipment or supply chains – and then theorizing about the impact those areas may have on one another. What the services lack is a complete understanding of how the data are interrelated. Data scientists would say the current data sets can give us a "descriptive" understanding of readiness, but not a "diagnostic" understanding - and certainly not a "predictive" view on the issue. With advanced analytics, organizations can break down those silos to see the larger picture, with the full view of interrelationships.

A brief look at weather forecasting will help to illuminate these concepts. Meteorologists use a variety of instruments to observe and describe the weather. For example, their instruments may show the temperature is 86 degrees, the humidity is 61 percent, and the wind is blowing east to west at 8 miles per hour – this is descriptive analytics. Descriptive analytics tells us what happened (or what's happening now). In addition, meteorologists know there is a cause-and-effect relationship among the different weather elements. Air temperature, humidity, atmospheric pressure, and other elements interact to create thunderstorms, snowstorms, and other weather events. This is diagnostic analytics, which enables meteorologists to gain insight into why specific weather events occurred (or why they are occurring now).

Diagnostic analytics is an important building block and necessary step on the path toward predictive analytics. To forecast weather for hours and even days in advance, meteorologists have amassed an enormous amount of diagnostic data that provides them with the foresight into how weather elements are interrelated - that is, how they interact with each other over time. Meteorologists can also bring into play other inter-related variables, such as elevation, ocean temperatures, and air streams to build even more reliable forecasts. Weather forecasts are not 100 percent accurate, and the reliability of forecasts declines as we look further in the future. Nevertheless, the diagnostic and predictive capabilities of weather forecasting offer valuable insight and improve decision making for everything from picnic planning to rocket launches.

Military readiness systems currently contain the necessary data for descriptive analytics, such as equipment levels, maintenance schedules, spare parts



Predictive analytics represent game-changing leap over current practices[1]

inventories, supply chains, procurement pipelines, personnel levels, training, and other known readiness-related factors. The goal now is to create diagnostic analytics to model the extremely complex relationships among these variables across all the services worldwide. That is, how do the different data elements interact to cause or create actual readiness for the full range of potential missions? And, not just at the unit level, but across the entire military enterprise worldwide?

Establishing the measurable relationships among readiness variables presents a complicated, but not impossible task. Military commanders already have a strong feel for the cause-and-effect relationships among the variables – for example, whether training in one field translates into competence in another field; whether helicopters operating in Afghanistan's rugged terrain will be worn down at faster than normal rates; or how a 75 percent readiness level of a Close Air Support squadron impacts the mission of the troops it supports. Commanders are often asked to make such readiness assessments based on their knowledge, experience, and judgment regarding the meaning of the descriptive data. However, no commander or group of commanders has the ability to consistently and rapidly make a complex set of calculations and precise assessments of readiness – quickly and accurately – across the entire spectrum of readiness data now available to decision makers.

Fortunately, highly accurate advanced analytics are no longer aspirational – they are now within reach of every defense organization. Thanks to breakthroughs in data science, these advanced forms of analytics are:

Technologically feasible. New approaches, designed expressly for the age of big data, have overcome the obstacles that have long limited analytics. Defense organizations can now bring together and explore their data in profound new ways.

Practical. Defense organizations have already done much of the groundwork, making the bar of entry to advanced analytics relatively low. And, new tools are making it possible for these organizations to ramp up analytic capabilities quickly, and put them directly in the hands of defense analysts and commanders.

Highly cost-effective. Substantially less time and effort are needed for data preparation and analysis, enabling defense organizations to increase their analytic output at lower costs. Organizations can save even more by using the advanced analytics to accurately target investments and cuts, and meet schedule and budget requirements.

Each of these factors is an outgrowth of rapid advances in data science. While it may be possible to conduct limited advanced analytics with current methods, they are typically too time-consuming and cumbersome to be of real value. With data science, what formerly took days, weeks or months to process can now be done in hours, minutes, seconds – or even microseconds. And we can now use all the data – and all at once – not just select subsets.

PROPOSED APPROACH: Building Data-Driven Readiness Models

Defense organizations do not need to break new ground to put advanced analytics into action. Other areas of government, particularly the intelligence community, have paved the way in using advanced analytics to guide decision-making. And, in the private sector, companies like Google, Amazon and Facebook have helped make sophisticated advanced analytics a part of our everyday lives.

The starting point for building a diagnostic readiness model is not the data, but the questions that need to be answered. For example, the data can tell us what experience and training a unit has, but military leaders need to know: Is it the right experience and right training for the mission at hand? The data can tell us a unit is ready to deploy at 80 percent of readiness strength, but the question is: How will the unit's decreased readiness impact the readiness of other forces and, eventually, the success of the mission itself? As we move from descriptive to diagnostic analytics, the emphasis shifts from the readiness inputs (data) to the readiness outputs (questions asked): What are the data telling us about our true state of readiness?

Productive diagnostic readiness models (and, eventually, predictive models) rely on a multi-disciplinary approach including both data scientists and domain experts. Data science itself consists of a variety of disciplines, including mathematics, probability and statistics, information science, data mining, data warehousing, advanced analytics, and machine learning. The domain experts are those with military mission and readiness experience, people who understand the factors that determine readiness and how those factors interact to create different levels of readiness. The domain experts also include the user communities participating in the readiness process and use the readiness systems. They understand the military's readiness reporting data, processes, and systems.

Toward this end, the combined team of data scientists and domain experts will focus on three interrelated activities as they build the diagnostic readiness model:

COMPILING THE DATA AND ENSURING ITS RELIABILITY

Data scientists tackle and resolve such questions as: Where does the data originate? Is it standardized? Is it accurate and up to date? Can it be readily accessed, stored, and combined with other data? Domain experts are essential to helping data scientists address these questions, because they understand the data being collected, where it is located, and what it purports to measure.

UNDERSTANDING RELATIONSHIPS (CAUSE AND EFFECT) AMONG DATA

Domain experts take the lead in this step, because they have the operational insight enabling them to understand the context and implications of the data, as well as the important cause-and-effect relationships among the data elements.

MODELING THE RELATIONSHIPS AMONG DATA

Data scientists with mathematical and statistical expertise will measure and map the data relationships and help create models that express those relationships. The algorithms and equations expressing these judgments and defining the relationships among variables can be programmed into the analytic models, as guided by the expertise and judgment of experienced commanders. Over time, the models themselves will also provide feedback to help refine the algorithms – that is, refine the mathematical expression of the relationships – to improve readiness forecasts.

Data, on their own, are relatively meaningless. However, using this collaborative approach, domain experts help the data scientist understand meaning in relation to mission readiness. Working together, the data scientists and domain experts draw on both their imaginations and experience to see how different types of data might be combined to create actionable insights. They may also posit hidden relationships that can be tested and refined. Intuition, as well as knowledge and experience, guide the development of analytic models. The multi-disciplinary team builds on progressive tiers of data collection, refinement, and analytics, combining rigorous scientific methodologies with deep domain knowledge and less tangible, but equally important skills, such as creativity, inquisitiveness, and collaboration.

The immediate goal is to gain greater insight into readiness at the unit level, and then to see how the various measures of readiness interact to create overall service readiness to meet specific missions. In addition, the creation of a diagnostic readiness model puts in place the foundation for predictive readiness models. The creation of these models will have many positive effects, such as helping the services to:

- Improve the access to and reliability of the data in addressing current issues related to data collection, siloed systems, etc.
- Refine and enhance the questions asked of data
- Identify and measure the right readiness activities and variables
- Allocate resources more optimally to maximize the required readiness of forces
- Incorporate lessons learned from commanders
- Increase understanding of the relationships among readiness variables
- Apply machine learning to improve the algorithms and sharpen the insights

Improvements here will work together to enhance the reliability of the diagnostic and predictive analytics models. As a result, military leaders can significantly improve insight into three areas of readiness: actual readiness at the unit level (based on current readiness data); implied readiness of the larger entity (resulting from the improved unit assessment); and future readiness of the larger entity (based on the long-term impact of current readiness factors).

The level of precision or confidence in the model's calculations will decline as we move down each of these three areas (actual, implied, future). That is, we will have more confidence in the model's assessment of current readiness at the unit level than in its predictions of future readiness, just as the reliability of weather forecasts declines as we look further in the future. Defense organizations possess the necessary fuel – their massive data stores and rapid progress in data-driven decision-making. The defense community is now well positioned to move to predictive analytics. By adopting the most recent advances in data science technologies and approaches, defense organizations can make a smooth, cost-effective transition from hindsight to foresight.

BOOZ ALLEN: Your Essential Partner In Data-Driven Readiness

Booz Allen Hamilton worked with the intelligence community – the earliest government adopter of advanced analytics – to develop many of these data science breakthroughs, which have been proven in the fight against terrorism. We are now helping forward-looking defense organizations leverage advanced analytics that are technologically feasible, practical, cost-effective and secure. The time is right for the defense community to capitalize on this progress – and harness predictive analytics to support the warfighter, and drive mission success, in powerful new ways.

Booz Allen has a strong history as a leader in innovative readiness activities. For decades, our projects have focused on groundbreaking improvements, developing technical systems and pioneering operational enhancements. For example, the Booz Allen Readiness Center of Excellence, located in Norfolk, Virginia, focuses on formalizing best practices and applying innovation to deliver readiness solutions with increased schedule and cost efficiency for military services and defense agencies.

Our Data Science team was established in 2010 as a natural extension of our business intelligence and cloud infrastructure development work. Understanding the need for a new approach to distill value from our clients' data, we built a multidisciplinary team of computer scientists, mathematicians and domain experts to tackle the collection of problems and opportunities for leveraging data. Their collaborative effort immediately produced new insights and analysis paths, solidifying the validity of the approach. Since that time, our Advanced Analytics and Data Science team has grown to support dozens of clients across a variety of domains. This breadth of experience provides a unique perspective on the conceptual models, tradecraft, processes, and culture of Data Science.

Backed by data science and advanced analytics, Booz Allen helps readiness domain experts and decision makers see a more complete picture that begins to reveal probable cause and effect. This move – from hindsight to true insight to foresight – empowers decision makers to act quickly, intelligently, and confidently to achieve their missions and goals.

OUR EXPERTS

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About Booz Allen

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