Booz | Allen | Hamilton

INFRASTRUCTURE & ENVIRONMENT

OPTIMIZING YOUR MILITARY INFRASTRUCTURE PORTFOLIO

CONSULTING | ANALYTICS | DIGITAL SOLUTIONS | ENGINEERING | CYBER

THE POWER OF ENHANCED DATA COLLECTION, ANALYSIS AND VISUALIZATION

AGING INFRASTRUCTURE, AGING SOLUTIONS

The Department of Defense (DoD) is struggling to maintain its enormous infrastructure portfolio in support of both current and anticipated mission requirements. Although the department spends about $20 billion annually on facilities sustainment, restoration and modernization, a recent DoD report rated 32 percent of its facilities worldwide in "poor" or "failing" condition.[1]

Several related problems hinder DoD's efforts to shore up deteriorating infrastructure. Key among them are budget cuts, which have reduced proposed funding for facility sustainment to just 74 percent of requirements, in contrast to the department's goal of at least 90 percent. As a result, many facilities are operating well beyond their intended service life. In addition, the military services are carrying excess capacity of about 20 percent, including 30 percent in the Air Force, thus adding to the sustainment burden.[2] Compounding these issues, the methods DoD uses to collect and analyze infrastructure data to make portfolio management decisions are quite labor-intensive and costly.

The challenges relating to data collection and analysis merit deeper discussion. DoD manages more than 24.9 million acres of land worldwide, occupying 276,770 buildings comprising more than 2.2 billion square feet.[3] These locations also contain 178,113 structures (e.g., towers, storage tanks, piers, and wharfs), and another 107,092 linear structures (e.g., runways, roads, pavement, fences, and electrical distribution lines). To inspect and help determine what infrastructure is in need of repair, upgrade, or replacement, DoD currently sends out inspection teams to physically observe and evaluate each building, tower, road, pipeline, etc. The team manually gathers assessment data and often stores it in disconnected systems, thus preventing the sharing of information for advanced analytics or enterprise-wide analysis. Errors can creep into the data through manual input or the subjective assessments of individual inspectors. The time-consuming method of physical inspection also means that years—and sometimes even decades—may pass between inspections.

Most problematic is that current practices for inspection and data collection do not generate the insight necessary to guide effective decision making for infrastructure investments. With much of the data stored in silos, it is difficult to meet the demands for timely, accurate, and integrated perspectives that drive well-informed, portfolio investment decisions. As a result, decision makers often focus narrowly—and inefficiently—on their most immediate needs, because they do not have the tools or information that can provide a strategic view of how best to optimize infrastructure in support of current and future missions.

Clearly, this kind of "business as usual" approach is not sustainable. The challenge is this: *How can DoD leaders improve their ability to make informed and effective infrastructure investment decisions—decisions that are consistent with an enterprise-wide infrastructure management strategy—in today's budget-constrained environment?*

Current practices for infrastructure inspection and data collection do not generate the insight necessary to guide effective decision making for cost-effective investments that align with mission priorities.

DYNAMIC DATA COLLECTION AND PROCESSING ADDRESS MODERN INFRASTRUCTURE CHALLENGES

DoD leaders can gain the insight they need for objective, data-driven investment decisions by incorporating commercially available technologies and solutions into their infrastructure inspection, analysis, and decision making processes and tools. Defense organizations are already familiar with these technologies, such as unmanned vehicles and sensors, which they are using to support other mission areas. The key is understanding how to apply the technologies to address modern infrastructure challenges and needs. In fact, many commercial companies have already begun using some of these tools to inform their infrastructure investment decisions.

The main elements underlying this new perspective for improving infrastructure assessments and decision making include:

- **Innovative Autonomous Data Collection Platforms.** DoD organizations can accelerate data collection by using unmanned aerial vehicles (UAVs), ground vehicles, submersibles, and other autonomous platforms equipped with sensors. In addition to gaining easier access to remote or hazardous locations, these platforms can also fill gaps in current data collection. DoD could also repurpose existing platforms, such as satellites, to enhance data collection.
- **Multi-spectral Sensors.** Deploying video and photographic imaging, as well as infrared, topographical, and LIDAR sensors on fixed assets or autonomous platforms to collect real-time imaging and infrastructure data has proved very effective. Advances in storage and computing power have enhanced the ability of small, sensor-carrying platforms to collect and deliver valuable data.
- **Powerful Cloud Computing.** DoD organizations already collect large stores of data that can inform infrastructure management. At the same time, they can also take advantage of public or open-source data sets, as well as enhance existing data with new sensor data from unmanned systems and other sources. The maturing of cloud computing now enables organizations to store, access, share, and manage massive amounts of data mined from these varied sources.
- **Advanced Analytical Solutions.** Modern analytic tools can apply sophisticated algorithms and models to parse through large amounts of data to detect anomalies and trends, and conduct multi-dimensional analysis of potential problems, solutions, and costs.
- **Visualization.** Modern decision making tools can integrate and present complex analytic findings in dashboards and other displays, providing decision makers with a realistic picture of the infrastructure situation in a 3D/4D virtual or alternative visual reality (e.g., simulations, holograms, and multidimensional analysis). This enables them to clearly analyze and compare investment trade-offs across their entire infrastructure portfolio.

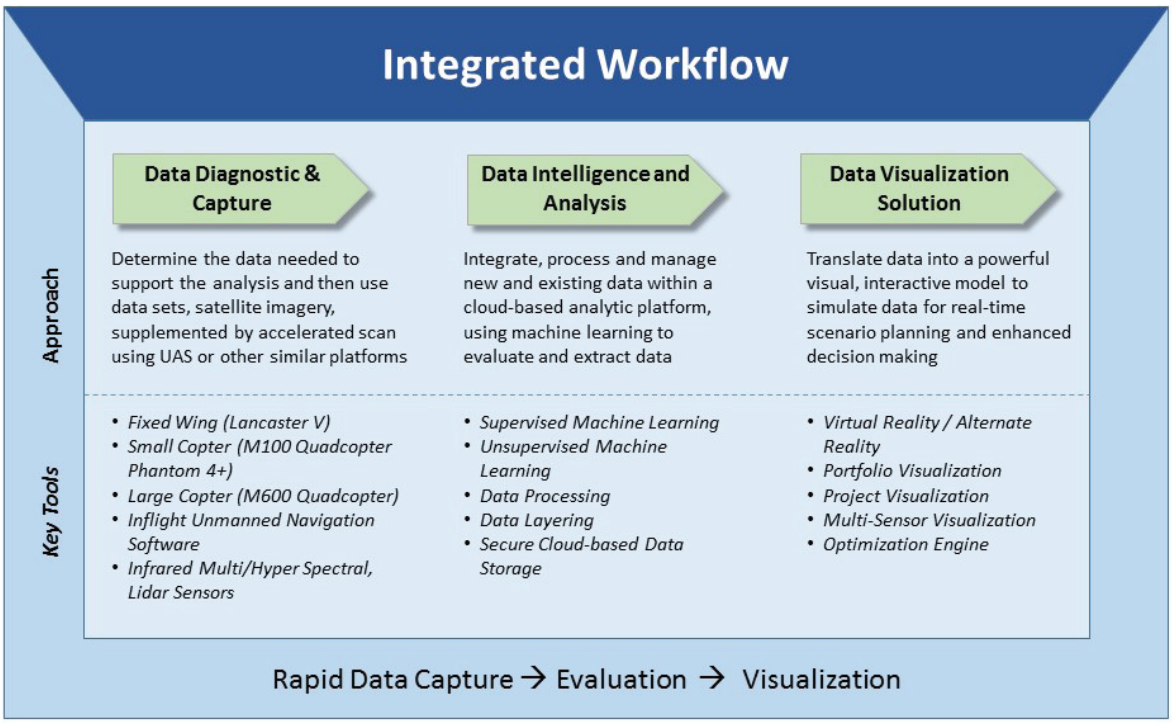
Applied together, these advanced technologies offer many opportunities to accelerate the data collection process, generate added value or return on investment for existing data, and create new efficiencies and solutions that go far beyond the 1950's-style inspection methods currently in place. For example, UAVs and other data collection platforms, combined with next-generation analytics and data visualization, can anchor a more efficient, accurate and timely assessment approach – and at a substantially lower cost than physical inspection teams. Infrared UAV sensors enable surveys of an entire infrastructure portfolio, efficiently pinpointing structurally unsound or impaired areas of concern.

Equipped with LIDAR to establish a building's 3-D structure and GPS to supply coordinates of a particular building, UAVs can utilize infrared capabilities for surveillance of larger groupings of buildings in a single flight. Thus, as opposed to inspecting buildings individually, airborne infrared sensors allow for an expedited analysis of potential structural issues in a base-wide facility portfolio.

The advantages of using unmanned vehicles to inspect buildings also hold for inspections of other types of structures, such as towers, bridges, and fences. This allows the teams to conduct surveys more rapidly and on a more regular basis. The inspection processes are repeatable and the sensor data are reliable, measurable, and shareable, while the automated inspection reporting gives decision makers on-demand access to an objective, enterprise-wide view of their infrastructure portfolios, significantly shortening the inspection cycle. It should be noted that physical teams are still necessary—for example, to inspect infrastructure where sensor data have indicated a problem, such as steam pipe leak, excessive corrosion, or unwanted moisture. But the overall reduction in the need for physical inspections to discover the issues will reduce costs while increasing worker safety, particularly when inspections cover large expanses or include rugged, difficult-to-reach locations and confined spaces.

INTEGRATING RAPID DATA COLLECTION, ANALYSIS AND VISUALIZATION FOR BETTER DECISIONS

Capitalizing on these new technologies will require a new approach to inspecting infrastructure, analyzing the data, and presenting the results to decision makers. The goal isn't simply to collect more data, but more importantly, to replace outdated practices with more powerful, cost-efficient methods, while also leveraging existing data sources. To extract maximum value from the collected data, the new approach will integrate the diverse data sets to facilitate rigorous analytics and present a comprehensive, enterprise-wide view of the infrastructure portfolio. Of course, each military base or



installation will have its own unique infrastructure and mission requirements, and so, ultimately, we must tailor the technologies to those requirements and needs.

As shown in the figure below, our approach depends upon the consistent application of rapid data collection, analysis, and visualization. Each engagement will typically involve the following phases, although they may manifest differently depending on the need. But this represents the most effective engagement plan to incorporate commercially available technologies and solutions into infrastructure inspection, analysis, and decision making for defense and intelligence organizations.

The first step involves developing a diagnostic of existing data and client needs: What data does the organization already collect or have on hand? What additional data do decision makers need to effectively assess their infrastructure and plan investments? Data collection and analysis represent a complex and challenging undertaking due to a number of factors, such as lack of relevant data, an abundance of data, the high cost to collect data, data anomalies, multiple data systems, and gaps that limit the ability to conduct integrated analysis.

With this insight, the next set of activities focuses on filling gaps and accelerating data collection using innovative platforms and sensors, as well as open source and untapped data sources (e.g., weather), and techniques to enhance data, such as geotagging. In particular, advanced unmanned systems and sensors can provide inspection coverage that is deeper, wider, and more reliable, giving decision-makers tremendous visibility into their infrastructure portfolio.

We then establish the processes and controls for connecting accurate, timely data. Accurate data provide the foundation for high-end analytics and the development of alternatives. It is essential for identifying efficiencies, tracking trends, and making process, facility, and equipment adjustments, as well as for demonstrating and quantifying actual cost savings, efficiencies, and schedule improvements. Identifying the right data sets and knowing what to analyze requires staff with expertise and knowledge in facilities, public/private partnership process, power/energy, water/waste water, and the organization's mission.

This expertise, when combined with strong communications skills, an ability to work across functional boundaries, and an understanding of the linkages and synergies of data help to achieving operational, cost, and schedule goals.

The final set of activities focuses on providing results by strengthening decision making through modeling, simulation and machine learning. Organizations can get a significant return from their expanded data collection by applying advanced decision making tools and techniques, which allow for complex, dense sets of data to be analyzed faster and more cost effectively. These tools can analyze enormous data sets to highlight the anomalies and trends that vary from the rest of the set. In addition, the tool's capacity for multi-dimensional analysis enables it to study more factors at one time, allowing the analyst to understand how each variable relates to the others.

This capability helps organizations pinpoint and resolve problems within a large infrastructure portfolio, with limited time and resources. Moreover, this activity creates an integrated alternatives analysis—e.g., including efficiency, productivity, and investment prioritization—that generates clear recommendations and enhanced decision making consistent with the infrastructure management strategy.

BOOZ ALLEN: YOUR ESSENTIAL PARTNER IN OPTIMIZING INFRASTRUCTURE INVESTMENT

Booz Allen has decades of experience exploring, analyzing, and addressing complex infrastructure challenges with U.S. government agencies. We have been at the forefront of groundbreaking efforts to improve both built and natural infrastructure management. We deliver leading-edge expertise across the asset management lifecycle and bring a strong understanding of critical infrastructure elements, including planning, capital project management,

operation and maintenance, energy, space management, water and natural resources, security, and resilience.

Domain Experience. With more than 1,000 subject matter experts on Infrastructure, Energy, and Environmental issues, we can assist in solving some of your most complex challenges. We understand that each service branch and each installation has unique infrastructure and mission requirements. Our tailored approach combines deep understanding of the DoD asset management lifecycle and the planning, programming, budgeting, and execution (PPBE) cycle, to ensure a comprehensive view of issues and solution development. Our experience integrating planning and execution activities adds accountability throughout the project lifecycle to ensure mission objectives, cost, budget, and key stakeholder requirements align throughout the process.

Data Science and Advanced Analytics Expertise. Seeing 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 Data Science team has grown to more than 600 staff supporting 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.

Strategic Partnerships. We have examined and tested the critical technologies and solutions essential to the new approaches for infrastructure management; and we have formed partnerships with many of the leading providers of unmanned systems, sensors, and other technologies. We bring an objective eye to our assessments of competing technologies, which allows us to select the best solutions for our clients.

Our experience, expertise and strategic partnerships are especially well-suited to helping agencies implement new approaches to infrastructure inspection, data collection, analysis, and visualization. Booz Allen is committed to providing proven tools and technology to accelerate diagnostic and data gathering efforts, establish meaningful data connections and improve infrastructure portfolio investment decision making capabilities.

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NOTES

1. *Statement of Mr. Pete Potochney, Performing the Duties of Assistant Secretary Of Defense (Energy, Installations and Environment) Before the House Appropriations Committee Subcommittee on Military Construction, March 3, 2016, p. 5.*
2. *Ibid, p. 14.*
3. *"Base Structure Report – Fiscal Year 2015 Baseline: A Summary of the Real Property Inventory," pp. 7-8.*

OUR EXPERTS

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About Booz Allen

Booz Allen Hamilton has been at the forefront of strategy and technology for more than 100 years. Today, the firm provides management and technology consulting and engineering services to leading *Fortune* 500 corporations, governments, and not-for-profits across the globe. Booz Allen partners with public and private sector clients to solve their most difficult challenges through a combination of consulting, analytics, mission operations, technology, systems delivery, cybersecurity, engineering, and innovation expertise.

With international headquarters in McLean, Virginia, the firm employs more than 22,600 people globally and had revenue of $5.41 billion for the 12 months ended March 31, 2016. To learn more, visit BoozAllen.com. (NYSE: BAH)