DEFENSE BUSINESS BOARD

Submitted to the Deputy Secretary of Defense

Audit/Performance Data Use in Private Industry

DBB FY20-02

An assessment of how the audit data and analytics is used in the DoD and an examination of how private industry uses data from financial statements, transactions, and performance to inform decision-making. This will result in the identification of leading practices for adoption across the Department of Defense.

November 10, 2020

21-S-0377

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EXECUTIVE SUMMARY

TASK:

The Defense Business Board (DBB) was asked by the Deputy Secretary of Defense (DepSecDef) to review the current data management and analytics practices of the DoD as well as the leading practices in the private sector regarding the use of financial audit and transaction level data to run, improve, and transform business outcomes.

The Terms of Reference (ToR) provided by the DepSecDef included nine interrelated tasks for the DBB to study. These ranged from assessing the current state and recommending potential improvements in the DoD, to identifying the leading practices in the private sector and their potential application to the DoD.

NEED:

There are four main issues underscoring the urgency for DoD to develop a more strategic approach to using its data for internal improvements.

The first is the China threat and, in particular, the Chinese government's adoption of a "whole of society" approach to national datasets and analytics, including those of all foreign people and firms. China's data is collected and utilized under their "Civil-Military Fusion" doctrine and supported by its Cyber Security laws and initiatives to set global security rules advantageous to its own purposes. This approach was began with Xi Jinping saying China needs to "promote the deepened integration of internet, big data, and artificial intelligence with the real economy." The implications are significant – the advanced use of data and analytics in an increasingly digital world to drive superior warfighting capability and readiness, and provide the crucial "back office" support that includes supply chain & logistics, focused and mission-driven acquisition and process transformation to reduce costs and increase speed. The DoD is in a unique position within government and the Nation to help lead a similar "whole of government" drive. The great danger is that, if we don't act fast, we will lag behind our major competitor in the new world of digital warfare and capability.

The second is the increasing cost pressures on budgets and defense spending, creating the need to transform key processes, gain decision-making insights into operations while better understanding opportunities and levers to utilize data and analytics to drive efficiencies, enhance readiness, and improve accountability.

Thirdly are the increasing demands for transparency in spending, costs, trends, and asset status.

The fourth is the accelerating pace of development in data, analytics, and artificial intelligence (AI) technologies. This means any hesitation, "business as usual" attitude, or delayed implementation will result in the DoD falling further behind peer competition and private industry. For example, the Chinese use and thinking of applying AI to its military capabilities has been documented in various research publications and articles.

APPROACH:

The Task Group (TG) interviewed approximately 50 individuals, over a 45-day period, from both the private and public sectors, and conducted significant research on best practices. In those areas

where the tasks required much more detailed analysis and research than was possible in the given timeframe, the TG chose to include in the recommendations a suggestion the DoD address such items in a more detailed and focused fashion. The full DBB reviewed and considered the TG study and approved its content.

KEY OBSERVATIONS:

The detailed findings relating to this project are outlined in the balance of this document. A key point to be noted here is the DoD is not unique. Leading private companies are struggling with the same issues as the DoD – those of culture, governance, data quality, analytics development, and workforce talent and skills. The DoD is, however, lagging behind the leading private sector companies in data management and analytics, and must act with a sense of urgency if it is not to fall further behind them and America's chief strategic competitor. The Chief Data Officer (CDO) and leadership of the DoD Data and Analytics initiative are aware of what needs to be done, but DoD's lack of adequate funding provisions for these initiatives, and the need for a more mandated versus voluntary approach, is evident.

The following are some key observations based on the TG's work and the DBB's related review and conclusions:

- **Data Strategy:** Private Sector best practice includes a Data Strategy as a foundational element of an overall Enterprise Strategy. These Data Strategies usually call for a written and comprehensive data management strategy that is clearly defined, consistently applied, and well documented. That document should include standard data definitions, processes and outline governance, responsibility, and accountability for data and analytics. It should also make clear, and leadership should enforce the message, that all data is owned by the overall enterprise (i.e., DoD), not the individual units within the enterprise. Private sector best-practices also include annual certifications in connection with internal controls, data quality, consistency, and timeliness. The new *2020 DoD Data Strategy* published in early October, while identifying the major vision and foundational elements, does not address actionable execution plans, timelines, priorities, or the accountability for implementation. The current strategy of adopting "data lakes," such as the Advanced Analytics (ADVANA) and Vantage initiatives, are part of the principal practices adopted by the leading private firms. However, despite the fact data sharing is practiced in the DoD, much of this data distribution is not DoD-wide nor comprehensive; it is currently facilitated by a "carrot" and "not much of a stick" approach, and is hindered by a culture operating under operational "silos" and governed by title 10.
- **Data Quality:** DoD has significant data quality, reliability, consistency, and completeness challenges. Military operational systems (i.e., mission) are generally in much better shape than business management systems (i.e., mission support). Regardless, it is critical the DoD arrive at a **"single source of truth"** for its critical data, prioritized on a combination of what front line personnel feel is critical to accomplish the mission and what top management feels is critical for planning, management, and oversight purposes.
- **Governance and Data ownership:** The DoD has made significant strides with the establishment of the DoD CDO and the CDO Council. The *2020 DoD Data Strategy* states:

> *The CDO Council, chaired by the DoD CDO, will serve as the primary venue*
> *for collaboration among data officers from across the Department. This*

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body will identify and prioritize data challenges, develop solutions, and oversee policy and data standards of the Department. While working closely with the appropriate governance bodies, members of the CDO Council must also advocate that data considerations be made an integral part of all the Department's requirements, research, procurement, budgeting, and manpower decisions.

However, the CDO position (and the CDO Council) is neither empowered nor does it have a budget with which to implement published strategies. Despite the number of CDOs and responsible officials for data in the Services and DAFA, and the recent *2020 DoD Data Strategy*, there is still some confusion regarding data ownership inside the Department. The DoD is comprised of many "siloed" organizations that do not have a culture of formal data sharing and collaboration, and who tend to unilaterally build and customize their own systems, business processes, and data standards. This creates a challenge for DoD component interoperability and greater use of this data. Without a single, coherent, authoritative enterprise-wide master data strategy, many future uses, DoD-wide analytics, and expansion of scope will be limited. In leading private industry companies, enterprise-wide data standards are set, and data owners are held accountable by management for any non-compliance.

- **Cultural attitudes within the DoD:** The Task Group's interviews revealed there is a cultural shift that must be made to convince senior leadership in the Services and DAFA of the value of the financial and operational data and analytics in improving processes, reducing costs, increasing readiness, innovating functions, and in driving fiscal and process discipline. This extends to the value of data as a "critical weapons system," the value of data-driven analytics for core decision making, and the direct relationship of all of these in achieving the 2018 National Defense Strategy (NDS) objectives and cost goals. Equally important, there appears to be a lack of appreciation and urgency in the data-driven "burning platform" on which the Department stands. The good news here is that the Secretary of Defense (SecDef) and DepSecDef understand this and are behind it.

- **Enterprise information systems proliferation:** DoD has thousands of legacy and non-integrated business information systems needing to be rationalized as part of a comprehensive data management plan. End dates need to be firmly set for outdated and non-integrated information systems and investments need to be curtailed for such systems. While some of this is taking place, it is not coordinated or fast enough.

- **Analytics** Advanced data analytics will not be fully effective until data quality improvement efforts have made considerable progress. Leading companies have found that the most valuable insights in operations, competition, capability and trends, to name some areas, are derived from cross-organizational and cross-functional data. Hence, it is imperative the data is common and shared. In addition, it is critical that analytics start at both the operations front-line level and the executive level. In the "value chain of data" the core data is generated, critical decisions made at the front-line, while major decisions are made at the executive level – both are necessary.

- **Workforce:** The DoD has a shortage of "data warrior" skillsets critical to the development and execution of a data-driven warfighting machine. Among the reasons cited are an onerous and lengthy hiring process, inappropriately focused hiring requirements, and difficulty in attracting the necessary talent.

- **Executive Reporting:** A very encouraging trend is the decision of top leadership to make it clear DoD decisions will be made on the "one source of truth" data from the ADVANA data lake. However, there is still a prevalent Department culture of "decision by PowerPoint" – the practice

of selecting and massaging the data and presenting it on Power Point slides for decision. Making. An important aspect observed is the lack of involvement of all stakeholders and the "end customer/users" in designing analytics and dashboards. DoD must ask and answer the question 'what is the problem(s) we need to solve today and tomorrow?' when designing executive reporting.

DBB Data Study Key Recommendations:

Based on the above and other findings, the Task Group is making a number of recommendations. They are addressed in the responses to each of the ToR's tasks and outlined at the conclusion of this study. A few key recommendations, however, are noted below:

Develop and execute a comprehensive Change Management and Communication Program to get the DoD, at all levels, to recognize the criticality of transforming DoD to a data-centric enterprise with data as a world-leading "critical weapons system" and the gap which must be closed to achieve this state. More needs to be done to help top military and civilian leadership understand the importance and value proposition of the key imperatives, data and analytics, and how they can serve to achieve the national defense goals, efficiency, and cost reduction. An important part of this would be the continuation of the insistence by senior leadership that all meetings should use live electronic data from approved data pools, with decisions made based on this data.

Operationalize the recently released *DoD Data Strategy*. The Strategy encompasses many of the TG's observations, findings, and recommendations, and so we shall not separate them. It bears mentioning the data strategy should include the "single source of truth," "enterprise-wide" standardization, processes, and data lake concepts (e.g., the ADVANA and Vantage initiatives) that are part of the principal practices adopted by the leading firms.

In terms of the overall vision, however, this quote from the *DoD Data Strategy* "Bottom Line" articulates the position:

> *The DoD Data Strategy supports the National Defense Strategy and Digital Modernization by providing the overarching vision, focus areas, guiding principles, essential capabilities, and goals necessary to transform the Department into a data-centric enterprise. Success cannot be taken for granted…it is the responsibility of all DoD leaders to treat data as a weapon system and manage, secure, and use data for operational effect.*

The TG feels, however, this needs to be extended in vision to include the adoption and operationalization of the **"Industry 4.0"** set of guidelines and elements – *"Enable autonomous decision-making processes, monitor assets and processes in real-time, and enable equally real-time connected value creation networks through early involvement of stakeholders, and vertical and horizontal integration."* It bears pointing out the TG believes America's major competitor and adversary, China, has adopted this.

Empower the newly established Governance structure of the CDO and CDO Council to develop and implement the Strategy, and fund their initiatives. A Federalist CDO Council structure is

consistent with industry leading practices, but must be extended to include senior data owners from all the Services, DAFA, and the Fourth Estate. This council would be responsible for developing and implementing the DoD-wide data strategy and the data, and funded to execute this effectively. The governance model must include a system of accountability for standards adherence and data accuracy from point of creation throughout senior ranks and within organizations. This would hold both military and civilian leaders accountable for the quality, consistency, completeness, and timeliness of their data, including incorporation into annual fitness and performance reports.

Address the critical workforce and skillsets issues through a variety of strategies. These include the expansion the DoD Corporate Fellows Programs, establishing high velocity "express lanes" for hiring "data warriors," and recognizing, in terms of hiring requirements and value proposition attraction, these "new" types of people are not always the "traditional" types found in the DoD.
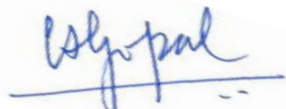
Rationalize the existing collection of Business Information Systems, with end-of-life dates, budgetary incentives and consequences, and standardization of the systems acquisition process**.**

The issues of Dashboard development at all levels of the organization must be given high priority. This is one of the visible competitive edges of a data-driven enterprise. It must include a few critical Key Performance Indicators (KPI) at each level, and be based on the most critical financial, operational, and other data needed by top management and the operators on the "front-lines." It must include visualization experts and encompass thought leadership in terms of analytics and algorithms for descriptive, predictive, and prescriptive analytics.

The use of Financial and Operational Data generated from the DoD Audit must be used to assess performance and trends, improve processes, increase readiness, reduce costs, increase efficiencies, and innovate functions across the enterprise, from sourcing and acquisition to logistics, inventory, and receivables.

The TG believes its detailed Findings, Observations, and Recommendations will provide the foundation for developing a quick-hit action plan, based on a "Minimum Viable Products" approach, with milestones, accountabilities, and measurement.

Respectfully submitted,

Dr. Christopher Gopal
Task Group Chair

PREFACE

This study, *Audit/Performance Data Use in Private Industry*, is a product of the DBB. Recommendations provided by the DBB are offered as advice to the DoD.

The DBB was established by the SecDef in 2002 to provide the Secretary and Deputy with independent advice and recommendations on how "best business practices" from the private sector's corporate management perspective might be applied to overall management of the DoD. The DBB's members, appointed by the SecDef, are senior corporate leaders and managers with demonstrated executive-level management and governance expertise. They possess a proven record of sound judgment in leading or governing large, complex organizations and are experienced in creating reliable and actionable solutions to complex management issues guided by proven best business practices. All DBB members volunteer their time to this mission.

Authorized by the Federal Advisory Committee Act (FACA) of 1972 (5 U.S.C., Appendix, as amended), and governed by the Government in the Sunshine Act of 1976 (5 U.S.C. § 552b, as amended), 41 Code of Federal Regulations (CFR) § 102-3.140, and other appropriate federal and DoD regulations, the DBB is a federal advisory committee whose members volunteer their time to examine issues and develop recommendations and effective actionable solutions aimed at improving DoD management and business processes.

The management of this study was governed by the FACA, the Government in the Sunshine Act, 41 CFR, and other appropriate federal and DoD regulations.

TASK

In August 2020, the DepSecDef directed the DBB to establish a TG to examine how financial statement, transaction level financial, and performance data is used by private industry to inform decision-making, reform opportunities, and identify best practices for potential adoption across the Department.

Specifically, the TG was asked to:
- Review how DoD has used data in the past, describe any major challenges in using it for decision making, and identify any clear opportunities for improvement;
- Identify the leading private industry best practices of data management, analytics, dashboards, and decision processes;
- Examine how financial statement data and transaction level operational data is used in the private sector and how it could be applied to government (both for senior level decision making and for operational improvement);
- Share/explain analogous, world class private sector examples; and,
- Explain unique characteristics of the public sector that may limit or hinder application of private sector best practices and provide mitigation strategies, as appropriate.

At the conclusion of its review, the TG was asked to:

- Recommend how DoD can modernize its business practices to be more efficient, and leverage data for leadership decision making as DoD improves the quality of the financial statement and the underlying transaction level data;
- Provide specific recommendations and options for the presentation, periodicity, and organizational level of reporting financial statement and transaction level data to inform decisions;
- Provide specific recommendations and options for additional reform, to include tools and/or modifications to existing decision processes; and,
- Any other related matters the DBB determines relevant.

The ToR at **TAB A** guided the full scope of research and interviews for this study.

TASK GROUP

Dr. Christopher Gopal served as TG chairman. Other TG members include the Honorable David Walker and Mr. John O'Connor. TG support was provided by Col Charles Brewer, United States Marine Corps, DBB Military Representative; Mrs. Leah Glaccum, DBB Staff; and Mr. Web Bridges, DBB Staff.

TAB B provides biographies of the TG members.

This study, along with its findings and recommendations, was presented to the DBB membership at an open public meeting conducted by video teleconference on November 10, 2020, and after discussion and deliberation was approved unanimously. The briefing slides presented are found at **TAB C**, and any public comments received are at **TAB H**. A list of acronyms used may be found at **TAB G**.

PROCESS AND METHODOLOGY

The DBB adopted several approaches in parallel to evaluate existing audit and performance-related data and analytics management and practices. These included:

- Interviewing, using structured questionnaires, about 50 individuals, split between senior DoD leaders, senior private sector executives, and thought leaders. The list of interviewees is at **TAB D**. The questionnaires are located at **TAB E**.
- Researching the current state of emerging technologies and private sector leading practices using wide variety of secondary research sources and white papers. A list of literature reviews is at **TAB F**.
- Conducting reviews of DoD documents and studies on data, analytics, and strategy.
- Holding joint working sessions among the TG to review the findings and develop the recommendations.

THE STRATEGIC IMPERATIVE

Today's international political and economic environment is characterized by:
- The China threat, with its "whole-of-government" approach to big data, analytics and global supply chains – militarily and economically – with the military adopting this enthusiastically in order to enhance their warfighting capabilities.
- Increasing budget and expenditure pressures exacerbated by the Coronavirus stimulus infusions into the economy.
- Increasing demands for transparency and reporting in spending, status, outcomes, and assets.
- Rapid and exponential advances in advanced technologies, including robotics, autonomous systems, AI, machine learning (ML), and analytics, and the ubiquitous connectivity and computing, including the Internet of Everything.

This constitutes a "burning platform" where data is a core requirement and a critical weapons system.

To quote from a recent RAND report, Xi Jinping has said China needs to:

> *"[P]romote the deepened integration of internet, big data, and artificial intelligence with the real economy." [1]*

RAND estimates that:

> *Beijing intends for big data analytics to have broad applications across the government and the country as a whole; it is clear that China's national big data strategy is a whole-of-government effort. China's public security forces have been enthusiastic to adopt big data analytics; the capability would significantly enhance their ability to fulfill their missions. Chinese primary sources express a belief that mastery of big data analytics will better position China to win future military conflicts between great powers. China considers big data analytics to be a vital national resource. Beijing has shown particular interest in using big data—and, ultimately, AI—to improve a wide variety of PLA capabilities, … that mastery of big data analytics will better position China to win future military conflicts between great powers.[2]*

It is, therefore, a strategic imperative for the DoD to ensure complete, accurate, consistent data – "a single source of truth" - across all its operations and support systems, rationalize the thousands of financial and operational information systems, and utilize advanced big data analytics to effect transformation, make data-driven decisions, and drive NDS outcomes – all at the highest possible velocity. This data challenge applies to both mission and mission support data and analytics.

STUDY BACKGROUND

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[1] RAND, *China Views in Big Data Analysis*, 2020, p. vii. www.rand.org/t/RRA176-1
[2] Ibid.

In 2018, the DoD undertook its first financial audit with the intent to satisfy federal requirements in accordance with the Chief Financial Officers Act of 1990 (Pub. L. 101-57), which amended title 31, United States Code (U.S.C.), in order to improve the general and financial management of the federal government. The audit was completed in November 2018 and another performed in 2019. These two audits required the Department to develop transaction level data and is expected to assist in improving the accuracy and timeliness of such data, its availability to enable advanced analytics, drive transformation, standardize financial processes, and institute financial discipline.

Both private and public sector organizations are undertaking data-driven transformation programs. Constrained budgets, increasing uncertainty, and global competition have underscored the critical nature of data and analytics and their role in improving performance, increasing efficiencies, reducing costs, and transforming the organization.

DoD's wide-ranging missions require disparate components with expertise in almost every major business sector to include health care, global logistics, education, real property and facilities management, and personnel management. Each of these components is (or is among) the largest in their business sectors. Interviews revealed each has their own separate data management systems. In total, the DoD has over 10,000 different and disconnected data management systems and 4,700 data warehouses. In the financial management space there are over 326 different and separate systems. Very little of this data resides in one location, has "a single source of truth," or is accessible to operators and decision-makers. This is the core problem hindering and slowing the ability of the DoD to meet its goals, transform its operations, reduce costs, and maintain its superiority in the coming years.

Enterprise-wide business reform, highlighted as one of the NDS's three lines of effort, is a key SecDef priority for modernizing the Department and changing the way it does business. A foundational element of the broader NDS reform effort is the annual financial statement audit. In accordance with the Government Management Reform Act of 1994, the Department is committed to the audit because it is the most efficient way to evaluate controls, process and policy, identify inefficiencies, instill financial discipline, and drive outcomes. In this early stage of its audit process the DoD is interested in understanding how it's current audit, performance data, and analytics compares with that of leading private sector organizations as well as how it can begin using the audit data it does collect to drive improved efficiencies.

This study and the resulting recommendations are especially critical as information systems, advanced tools, data, and analytics technologies exist which can capture all types of financial and operational data, both from within and outside an organization, from all possible points on the globe and beyond. This will exponentially increase the capability of big data analytics, field access to data, and technological literacy.

SCOPE

The scope of this study provides a high-level management perspective on the following:
- DoD's current state of data management and analytics, and the challenges it faces.
- Leading Private sector companies' practices of data management and analytics, their challenges and how they have addressed them.
- Recommendations to take the DoD's data analytics practices from the current state to best practice.

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The following pages outline the TG's observations and findings for each of the ToR tasks.

The DBB's recommendations are summarized at the end of the study in a concluding section.

OBSERVATIONS AND FINDINGS

Task 1: DoD past data usage:

> *Review how DoD has used data in the past, describe any major challenges in using it for decision-making, and identify any clear opportunities for improvement.*

The DoD's use of data in the past can best be characterized as fragmented and in silos. This has been a function of the information systems and data condition and distribution with the DoD. Today there are four major general ledger systems inside DoD, which may *sound* manageable, but the underlying reality is very different. Thousands of fragmented disparate systems feed the various general ledger systems. DoD leaders are fairly consistent in their observations that the data can be incomplete, inaccurate, and inconsistent in format. The lack of standardization makes it very difficult to effectively use and analyze the data for accurate and real-time status, consistent measurement and cross-organizational insights for improvement, decision-making, or transformation.

In the past, the DoD has used static data as a tool to know where to focus. However, the low degree of confidence in the data (accuracy, completeness, consistency, timeliness) results in the DoD not using accurate or organizationally agreed upon data to make decisions, particularly if the data suggests the need for significant change.

An additional complicating factor has been the practice of some entities within DoD operating as semi-autonomous (or even autonomous) entities – resulting in more impediments to data sharing, more unique and custom systems, and the development of separate data and information system strategies.

Conditions, however, have begun to change and improve. In order to meet the challenge of disparate data sources across a vast enterprise, the DoD embarked on a data lake strategy for financial management transactions consistent with leading private sector organizations, whereby the data lake pulls in financial transactions from other systems into one location. This has resulted in the internal design and development of the ADVANA system - a "universe of transactions" to capture and store financial transactions. The ADVANA platform is the main source of data used by auditors and is recognized as the most reliable current data source inside the DoD for financial management information. The ADVANA platform has slowly begun to incorporate some operational data in addition to the core financial data – this will certainly help in analytics and insights. The insistence of the Secretary of Defense and the Deputy Secretary for senior leaders to use ADVANA directly in management meetings is helping drive the increasing use and trust in the ADVANA data, and an increasing willingness to share data.

The ADVANA platform is scalable, and based on interviews with leading private sector companies, is a good starting point for any organization, including DoD, as it begins the journey of capturing, cleaning and analyzing its own data. However, it still has to deal with the many organizational, cultural, and technical challenges in collecting data from less than willing entities across the enterprise, and taking the DoD to a world-class level on par with leading private companies.

Challenges

The DoD faces several challenges in data management, the effective use of audit and performance-related data, and analytics in the current environment.

Sourcing and collecting DoD data into one place is difficult.
The central ADVANA team does not have the appropriate access to enterprise data nor does it have the ability to verify and validate financial and operational data from across the entire organization. Interviews suggest the ADVANA team occasionally faces pushback in its requests to access legacy systems across the enterprise. This pushback is due to several factors, including:

- A prevailing siloed culture hindering the sharing of data.
- An unenforced mandate for data sharing inside DoD.
- The perception among senior agency leaders that upgrading the compatibility of legacy systems is a low priority in a constrained budget environment relative to the major goals of readiness and mission execution.
- A lack of understanding below the levels of senior DoD and business unit leaders of the value of cross-organizational data and analytics in achieving the goals.

The current strategy is an "all carrot/no stick" approach, as there is no top-down enforcement for data sharing. The ADVANA team often has had to work around the "siloed" culture within the DoD by creating a high-value product in order to entice organizations into sharing data. Organizations which voluntarily provide ADVANA with access to their data are rewarded with the ability to manage and analyze their own data inside ADVANA's analytics platform. This works for the organizations interested in ADVANA's analytic capabilities. The 'no-stick' approach is due in large part to the Office of the Secretary of Defense (OSD) not yet directly insisting that the Military Departments (MilDeps) and DAFA comply with the Fiscal Year 2018 National Defense Authorizations Act (FY18 NDAA) (Pub. L. 115-91) statutory requirement on data sharing. The FY18 NDAA's § 912(a)(1) amended § 2222(e) of title 10, U.S.C., by adding new sections. Paragraph (5) requires "The defense business enterprise shall include enterprise data that may be automatically extracted from the relevant systems to facilitate Department of Defense-wide analysis and management of its business operations." Paragraph (6)(D) requires:

> *The Secretary of Defense, the Chairman of the Joint Chiefs of Staff, the Secretaries of the military departments, commanders of combatant commands, the heads of the Defense Agencies, the heads of the Department of Defense Field Activities, and the heads of all other offices, agencies, activities, and commands of the Department of Defense **shall** provide access to the relevant system of such department, combatant command, Defense Agency, Defense Field Activity, or office, agency, activity, and command organization [in other words the entire Defense enterprise], as applicable, and data extracted from such system, for purposes of automatically populating data sets coded with common enterprise data.*

This situation must change.

The DoD's data is not always clean, complete, or consistent. Apart from the financial data validated by external auditors, the ADVANA team does not always receive clean data from entities inside the

organization. This is due in large part to the fact there is no [signed and enforced] data governance policy and consistent data standards inside the DoD. At one point, § 901 of the FY18 NDAA gave the rights to all enterprise data to the Chief Management Officer, but this authority was not acknowledged by various entities nor adequately enforced within the Department.

The Military Services and Defense Agencies and Field Activities (DAFA) have always had wide latitude to create and manage their own data, so it is natural that common data and costs are calculated and defined differently across the various organizations inside DoD. This will be difficult to change in an organic fashion given the DoD's history. However, this siloed approach is highly inefficient and serves to severely impede the development of an enterprise-wide view of the DoD's people, processes, inventory,

> Organizations like DoD must go through the process of collecting, cleaning, cataloging and organizing their data in a single location. Until this is step is completed, discussing the use of advanced data manipulation tools is a hypothetical conversation because their use is predicated on analyzing data that has been sourced, cleaned and organized.

condition, and supplies.

Advanced data tools are probably years away in terms of effective use and implementation. Leading edge data analytics tools, AI, and ML are tools most effectively used by business organizations with mature data models. In the broad sense, these tools are more representative of an aspirational end-state, but cannot be effectively used without being built on the foundation of a strong data management system. Until DoD has an enforceable enterprise-wide data strategy and access to all data necessary is accomplished, leveraging on advanced data tools is probably years away in terms of use and implementation.

Lack of the necessary skill sets and people. Organizations in the private and public sector, whether driving data-driven transformation, or just competing for survival, must have the talent necessary to manage data and effectively implement new platforms and increasingly sophisticated analytical tools. Interviews with DoD leaders provided a consistent picture that the DoD does not have the talent and skillsets necessary to make this digital transition into the new global environment. DoD currently is focused on hiring data scientists, data engineers, business/data liaisons, and experienced leaders. However, the process is slow, and the value proposition to compete against private companies is not yet well developed, considering these skills are the most competitive in the job market today. It is obvious, and a part of our Recommendations, that the DoD must change the way it hires, evaluates, retains, and rewards talent in these key areas. The practice of long hiring times, inability to remove poor performers, and outdated standards make this talent refresh, up-skilling, and augmentation difficult to execute. It is, however, an imperative. The recent proposal by the Defense Innovation Board of a 'Digital People's Officer'[3] to oversee the hiring and retention of scarce "data warrior" talents is a recommendation the DoD should adopt.

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[3] https://www.fedscoop.com/dib-digital-people-officer-recommendations

Benefits from the Audit

DoD demonstrated considerable initiative and foresight in initiating the annual audit. The audit process has identified a number of material weaknesses and a very large number of notifications of findings (NFRs) which, when remedied, will make the DoD more efficient and productive, and will provide it with strong financial discipline and controls. DoD has a robust governance methodology to identify, categorize, and execute suggested remediation recommended by each annual audit. The Financial Improvement and Audit Readiness (FIAR) governance board holds entities inside DoD accountable for implementing changes and then reports on this progress. Using this information as an internal control to improve processes has been successful within the Department. However, while the current DoD top leadership appreciates the impact an audit can have in terms of the data it produces, the analytics possible, and the value it can provide in achieving the Department's NDS goals, it is apparent the senior leaders and executives in the various subordinate components have not yet focused on the digitization of existing business processes.

Task 2: DoD business practices efficiency

> *"As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD can change its business practices to be more efficient."*

There are several opportunities for improvement in terms of process, people and policy, the impacts of which are amplified by both the continued inclusion of new datasets from entities across the organization and the urgency of the "burning platform" outlined earlier.

Implementation of the 2019 *Digital Modernization Strategy* regarding Data Governance

DoD published a digital modernization strategy in 2019 to guide the enterprise in its digital transformation. This 2019 strategy provides an assessment and recommendations for data standards and governance. However, the TG could not find a signed/published data governance policy and this would be considered an important subcomponent of the modernization strategic plan. Establishing and enforcing a data governance policy in the DoD will provide significant readiness, maintenance, and financial/cost benefits. This policy should include:

> **Business Practice Change 1**: Begin funding & implementing the 2019 Digital Strategy in terms of data governance and standardization, with the FY18 NDAA statute on data sharing across the entire DoD enterprise.

1. The aggregation of similar data across different organizations into a single data format.
2. Establishment of clear ownership of and accountability for the data which will result in accurate and complete data sets for making decisions.
3. Provide a clear mandate that the data management system (e.g., ADVANA) will have access to **all** data sources inside DoD.
4. Increase the organization's confidence in its data, which will drive a wider development and usage of organizational ad functional, as well as cross-functional and cross-organizational analytics.

CDO position and strategy harmonization:

The TG found most of the major entities in the DoD have established CDOs who are assigned the responsibility to manage a range of data-related functions which includes data management, ensuring data quality, and creating data strategy. Some are also responsible for data analytics and business intelligence - the process of drawing valuable insights from data. The CDOs are a critical part of the DoD's future warfighting and financial management capabilities.

> **Business Practice Change 2**: Empower the CDO and CDO council to implement published data strategies. Hold all CDOs accountable for the accuracy of their data as well as its availability to ADVANA; and their collaboration under the same rigor as a chairmanship of a corporate entity to develop and implement a coherent and consistent data strategy.

The creation of this role and the importance placed on managing data is crucial and a positive step. CDOs within the DoD enterprise have begun to meet and collaborate. The potential benefits to DoD resulting from accountable CDOs, a cohesive CDO Council, as chaired by the

DoD CDO and answering to the DepSecDef, and a standard approach are significant; it is a critical first step in building a data-driven organization.

Implement Incentives and Consequence Management based on budgetary and resource allocation:

Despite directives from DoD leadership and laws from Congress, entities inside DoD have not consistently complied in terms of data sharing, cross-compliant systems, and governance.

Often this non-compliance is framed within an argument that compliance may harm the mission of the entity. While it is possible there may be some impact in rare instances, these proposed deviations should receive adjudication from the SecDef or DepSecDef.

> **Business Practice Change 3**: Implement incentives and consequence management based on budgetary and resource allocation in the PPBE process, and as part of the annual performance appraisal and evaluation process.

In general, there needs to be more consequences inside DoD for entities which do not collaborate in data management, standardization, or sharing data with recognized/accepted data platforms. The most meaningful places to attach consequences for compliance and non-compliance are budgetary impact in the Planning, Programming, Budgeting, and Execution (PPBE) process - the annual budgeting process - and within the annual performance appraisal and evaluation process. The impacts must be meaningful enough to drive behavior change and should be decided and communicated at the SecDef/DepSecDef level.

Rationalize existing business systems

The DoD has made continued progress in bringing in data from systems across the enterprise into the data lake in ADVANA. However, the underlying fact is there are hundreds of financial, human resources (HR), procurement, operational, supply chain, and other systems collecting and using financial and operational data. Entities within DoD have a history of operating independently and autonomously, which includes developing their own set of legacy business systems. It is critical to a coherent data and analytics strategy these systems be rationalized, and the data input and validation process be standardized. The current environment is very costly, requires extensive and customized maintenance, and hinders any DoD-wide analytics and data-driven decision-making initiative. This opportunity compliments Section 2.2 (Goal 2) of the 2019 *Digital Modernization Strategy*.

> **Business Practice Change 4**:
> Begin the measured rationalization of the DoD business systems.

Implement a Center of Excellence to augment the expertise within the Services and DAFA

Currently, different entities inside DoD have hired their own individual groups of expertise and have built and operate their own data management platforms to provide them with varying degrees of analytical insights. The DoD has an opportunity to establish not only a centralized analytical platform common and used by all entities, but also to establish a center of excellence (CoE) for analytics embedding analytics experts inside each entity. The CoE will be tasked with developing new analytics and capabilities geared towards the NDS, operational execution, executive needs to "run the business" and anticipation of risks and developments. This is a practice employed by several leading companies in the private sector. In addition, the CoE will leverage best practices across the organization – those from the private sector and those developed by other agencies. The CoE should be central, reporting to the CDO Council, and have, as one of its missions, training data analytics teams from the Services.

> **Business Practice Change 5**:
> Establish a CoE for business analytics staffed with talent embedded with BUs and assigned with the task of helping them design and implement "run the business" and advanced analytics and metrics, consistent and cross-organizational, using the ADVANA platform.

Advanced Analytics and Metrics

Currently, the predominant level of analytical metrics used in the DoD can be described as descriptive, organization-specific, and functionally-specific. The DoD must change the paradigm on analytics from static (rear view) to predictive (windshield) and prescriptive (what should we do), to encompass cross-organizational and cross-functional perspectives. As an example of the effectiveness of senior management emphasis is the use of ADVANA in the Deputy's Management Action Group (DMAG), which has resulted in a flurry of requests of licenses and access to ADVANA and its capabilities and tools.

> **Business Practice Change 6**:
> Establish requirement for DoD organizations to design and use a combination of descriptive, predictive and prescriptive analytical metrics across organizations and functions in their operations and management discussions/decision-making.

Education, Communication and convincing all levels of the organization (particularly senior leaders) about the value and urgency of data and advanced analytics in meeting the NDS and financial objectives.

The performance metrics of the senior leadership inside DoD is (or should be) tied to the progress towards or accomplishment of the current NDS milestones. Services and agencies inside DoD spend considerable time and resources to accomplish their share of these NDS milestones. DoD has the opportunity to assist their entities by demonstrating the need for and strong benefits of an internal data analytics capability. Although interviews demonstrated senior and mid-level leadership inside DoD understand the value advanced analytics can add in meeting the NDS milestones, in the Services and DAFA it is imperative the leadership is convinced of this value and drives it in their organizations and across organizations.

> **Business Practice Change 7**: Develop the following as a means of education and communication across the DoD: A value proposition explicitly linking standardized data and intra-service/DAFA analytics with the NDS goals and cost goals.

Task 3: How DoD decision-makers can take advantage of data

> *"As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD decision-makers can best take advantage of this data?"*

Executives in the DoD understand there is are significant opportunities to improve existing business processes and capture savings using financial transaction data already being captured by the audit. Research shows poor data quality has proven to be a significant liability to organizations, costing them upwards of 15%-25% of their operating budget in terms of waste, overspending, redundancy, and expired funds[4]. For an organization the size of the DoD, these estimates could represent many tens of billions of dollars.

Leading private sector companies utilize the abundance of data and the resulting analytics to rationalize business processes. A large multinational beverage company used an analysis of its newly collected travel and expense financial data to reach the conclusion the current business processes in place to request, review, approve, pay, and reconcile travel expenses was no longer required. The company realized it could approve all travel expenses and analyze expense data after settlement to address (identified) problem expenses. The company analyzed the expense and travel data with an algorithm which examined records having unusual outliers or typical unjustified activity (for example: upgrading to First Class seating on a return trip). Any unjustified expenses were presented, quite visibly, to the offender's management chain. This process change quickly led to a rapid behavior change across the enterprise. This global company saved an estimated $100M in its overhead related to travel and expense management by using data to rationalize an existing business process.

Additionally, the TG learned that leading companies tend to focus this analysis on those business areas that drive the success of the business. This includes what is often called 'the back office,' front-line operations, and key enabling processes. As DoD's data quality continues to improve and corresponding confidence in this data grows inside the organization, these opportunities can be improved.

The opportunities can be arranged into five categories: People, Systems, Acquisitions, Expenses, and Logistics.

People:
- **Analyze personnel counts versus the actual need**. Most organizations realize, as systems and processes have become more efficient, the workforce has not been right-sized accordingly. Tools now exist to optimize work demand with human capital allocation.
- **Compute and standardize the fully burdened cost** of full-time equivalents across the organization. Private sector companies who perform frequent mergers use similar data to forecast the budgetary impact of headcount changes.

Systems:
- **Target redundant IT systems across the enterprise.** For example, once data from all HR enterprise resource planning (ERP) are collected, standardized, and analyzed, begin the transition to a shared services model, which ties into the 2019 CIO strategic plan.

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[4] https://searchdatamanagement.techtarget.com/podcast/Data-quality-trends-with-expert-Larry-English

Acquisition and Procurement:

- **Review Enterprise-wide Category Management Spending.** There are numerous examples of DoD experiencing price variances of 40% or more throughout the year on items such as chicken thighs, 2x4's, or even apple juice. Hundreds of millions of dollars are overspent when an aggregated view of enterprise-wide spending on a category would provide DoD leadership with the information to make better decisions.
- **Contract review.** A considerable amount of DoD's budget goes to paying contractors for products or services rendered. With a modest effort, the terms from every past and present contract can be pulled into a system which can reconcile whether product or service has been delivered on time and within the terms of the contract. This would be an automated process that could reduce significant spend on contract management labor and enable senior decision makers to simply review and handle exception reporting revealing problem contractors.

Expense reconciliation:

- The DoD has organizations managing and reconciling personnel and travel expenses. By collecting all travel and expense financial data into one system, DoD decision makers will have an improved view on spending patterns, behaviors and exceptions falling outside of norms. Although improved financial transaction data is a necessary ingredient for such improvements, with it the DoD could reduce labor and system costs dramatically by moving much of the approval process into an automated capability.

Logistics:

- Reconcile logistical costs, patterns (standard and mode v. expedited), assets and usage, location, and ageing.
- Analyze the fully burdened cost of using In-House v. Third parties to manage logistics.

Task 4: Identify leading private industry best practices

> *"Identify the leading private industry best practices of data management, analytics, dashboards, and decision processes."*

DoD's journey to improve the quality of both its data management as well as subsequent analytics can benefit from a review of best practices found in the private sector. These best practices are categorized by the following functions: data management, analytics, dashboards, and decision processes. These steps are most commonly developed in a sequential fashion. Each function relies on the accuracy and adoption of its preceding function for success.

Data management best practices:
- Leading companies spend significant time and resources in first developing a strong **data strategy**. Most leading companies utilize an approach starting in the 'trenches,' where accurate data and analytics will have the most impact. This is contrary to most organizations which focus on the top-down perspective.
- Make it easier to **access** existing and newly captured data. Greater amounts of data provide a larger sample from which to make predictions and establish patterns.
- Enhance the capabilities of your CDO's with **advanced analytical tools** such as statistical analysis capabilities inside the extract, transform, load (ETL) data flow. For example, a data frequency analysis spots data anomalies and missing values that, if not corrected, can negatively impact performance measures such as mean, median and average. These tools can also help data teams better understand statistical distribution and variance of new data sets, because un-scrubbed data is often not normally distributed.
- **Clean and validate the data**. Private sector companies suggest up to 40% of all strategic processes fail as a result of dirty data. This data cleaning process is normally implemented in the ETL process and takes place at the database level.
- Re-shape the data received through the ETL process using **flexible manipulation** techniques. Getting data ready for the analytical process requires merging, transforming, de-normalizing, and occasionally aggregating the source data from many tables into one large table, sometimes referred to as an analytic base table (ABT).
- Where possible, **share metadata** across analytical and data management domains. Common metadata layer across an enterprise enables data teams to repeat data preparation processes. This practice encourages collaboration and provides lineage information on the data preparation process so teams can trace where data came from. This practice normally results in improved productivity, better predictive analytics, faster cycle times, more flexibility, and auditable, transparent data.
- **Data Governance Council**. Leading companies have a Data Governance Council or Team, headed by the Corporate CDO – to decide on how data will be collected, managed, accessed, obtained, entered, and the processes to make sure it's accurate. The Council defines owners for all functional data, structures the data, and focuses on "the things that count." In a major world-wide logistics company with multiple business entities, this Team reports to the Executive Committee. Corporate data is viewed as an asset, so no one group owns it. Multiple groups manage their own data and have input into the Data Governance process.
- **Building a data culture.** Leading companies spend considerable effort to convince those in their organization to use data, share data, and make decisions based on data. To do this successfully,

it is critical organizations develop and articulate the "why" - value propositions linking data to business objectives, operational, and financial results. This should be coupled with anecdotes from other companies and from other parts of the company. Performance metrics include the monitoring of data completeness (many laggards look at data completeness as an afterthought).

- Many leading companies are using the **'data lake'** strategy, with a "Federal Data" governance structure. The data lake strategy accommodates different types of data in the organization, with no pre-processing. People can decide what they want to do, identify the necessary data, then clean it and put it into a common format (one has to transform it to make it useful), and run their analytics. It then is in a common format in the data lake. This saves magnitudes of time compared with traditional efforts to store data and access it.

- There are three flavors of organizational data management, but the leading private sector companies use the Federal model:
  - Monarchy (where mandates come from the top; but many Corporate Executive Officers (CEO) do not understand the value of data) – this does not work too well; one size does not fit all.
  - Federal (where some data needs to be shared and some data does not). The federal model organization has common standards, tools, practices, analytics and all are used by the individual Business Units. Federal is proving to be the superior model.
  - Anarchy – divisions inside the organization get to do whatever they want. DoD's history in managing data has leaned more towards this category, but with the creation of the 2020 Data Strategy, this is now changing into the Federal model.

Data Analytics

The best companies set up their own data science groups and use a two-pronged approach that includes (1) a corporate data science group and (2) a direct self-service model. The corporate group acts as a CoE with data expertise and leading practices knowledge to help the business units develop corporate metrics and analytics, and translate what goes on in the field to corporate and vice versa. The direct self-service model is used at the functional and business unit levels to develop their own individual analytics and metrics. It is a centralized-decentralized model.

Most importantly about analytics is they must be easy-to-use, and all the data should come from a "single source of truth." The goal is to have more discipline in the development of the analytics – to have people spend more time on analysis and problem solving.

Data Analytics best practices

1. Building an **analytics culture** in a large organization is hard and it takes time. Senior leaders often don't understand the difficulty level and often demand an organization implement next-generation analytics in unrealistic timeframes. Take the time to understand what's required from the analytics design and implementation teams to build this culture and provide full support.
2. **Predictive Analytics** is an important component of an advanced platform. Implementing predictive analytics requires several skillsets and initiatives – from the collection, cleaning, and organization of the data in an organization to the development of the analytics and algorithms necessary, up to the education of the people using them. However, the upside in implementing predictive analytics for most organizations is a game-changer. An oft-used analogy for this impact is the driver who can now drive using the windshield to see what's coming instead of using the rear view mirror to see what's just happened.

3. **Proof of concepts** are necessary. Companies successfully implementing predictive metrics often begin by focusing on a single business unit and then on a metric already being measured. The key is to use good data on a meaningful metric and test the predictive accuracy of the analytics to get them right.

4. Use **data outside the box**. The best way to explain this is with an example. A global organization is trying to predict overhead expenses for the coming year at each of its 500 locations across the globe. Instead of analyzing data generated from the past inside each location which might predict facilities expenses such as electricity, it augmented this analysis using third party geospatial location data and historical weather data to provide a much deeper and robust prediction on energy consumption in the near future. The best practice is to incorporate data above and beyond the standard data present in the data warehouse. The most common suggestions for external data is geospatial data.

5. **Budget for training**. Advanced analytics is now a main focus inside most large organizations. The available talent in the marketplace is scarce and demands premium compensation for their skillsets. Given the typical constraints for federal employment (i.e., lower pay, fewer benefits, long arduous hiring times, etc.) it is not likely the DoD will be able to compete in the recruiting of fresh new talent. A compensating approach might be to budget for and require the upskilling of existing DoD employees who can transform into a data analytics professional. With statisticians, data scientists, and data analysts in short supply, training the existing workforce will become critical.

6. **Control quality of analytics**. Pushing data analytics out into and across a global enterprise can also come with risks. As analysts in each business unit begin to get more familiar with advanced analytical tools, it is important to ensure quality review of their predictive data. These analytical tools are powerful, but bad input equals bad output and an organization with no controls in place could be making decisions with bad analytics.

7. **Make decisions using the data**. An interview with a professor revealed the common frustrations with nascent analytical efforts. Entire shelves are filled with analytical products suggesting cost saving or revenue generating results if certain recommendations are followed. The frustrations are this analysis is wasted due to inaction. Even organizations who are not yet confident in their analytics can take action, albeit manual action. The key is to demonstrate the organization is building a more analytically driven culture and good analytics, and this will result in action.

8. Build an **Analytics CoE.** Interviews with executives from leading companies who have all designed and build a robust data analytics capability have implemented CoEs in their organization. Based on private industry practices, the TG believes such a Center should report to the CDO/CDO Council for consistency and impact. CoE builds up a core cadre of experts trains the business units (BU) and their key people (technical and executive), runs joint development workshops with the BUs to ensure cross-organizational and cross-functional analysis, identifies and approves the tools and vendors in a common list, and defines a common view of analytics for the BUs. The CEO houses Analytics ambassadors and Automation ambassadors – they produce the dashboards, understand the domains, and can answer the "what's the problem?" In a few companies' cases, these "ambassadors/experts" have been housed in the CoE, with the BUs paying for them. Utilizing a CoE for analytics can ensure the design, quality, and practice of analytics is uniformly implemented across the enterprise. Additionally, CoEs can provide training, enforce data governance models, and communicate with data analysts across the organization.

9. **Analytical Development Process**.[5,6] Leading companies develop their own analytics, often using multi-disciplinary, multi-level workshops, so they all own the problem and solution. This is an

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[5] Davenport, Thomas. Competing on Analytics. The "DELTA+" model for world-class analytics.
[6] Data-Driven Transformation approach to Data & Analytics (Barb Wixom, MIT).

iterative process in the workshop and involves all aspects of the analytics, KPIs, incentives, etc. They have discovered no one group can develop it effectively in a solo fashion. In the effort to develop meaningful analytics, leading companies start by closely reviewing the mission and strategy. After this, they review business results, while asking the fundamental question 'what problem are we trying to solve, and what data will we need?'

10. **Centralization/Decentralization**: Leading companies are doing centralized data and corporate analysis and decentralized (BU/Functions) analysis. A major global, multi-BU consumer goods company, for example, has a Centralized but Embedded model (Central standards/CoE, but with analytics embedded in the BUs, with dotted line to the Centralized function). It is recognized analytics are at the "coal face" – they help solve the business problems. Data is owned and certified at the BU level – but standards set at corporate to avoid inconsistent models and processes. In leading organizations, this direction and leadership starts at the top. Although different BUs have their own unique elements, they all have significant similar components and processes. Leading companies have moved from "data owners" to "data trustees

Dashboards

Senior DoD leadership recognizes the value of dashboards and has already begun to design and implement them at the highest levels inside itself as well as inside its business units. However, there are a number of best practices around dashboards in the private sector which may be helpful.

Best practices for dashboard design:

1. Design & Layout

The data behind dashboard metrics can be complicated, but the purpose of the dashboard design must be simple, concise, and clear. Dashboards should provide the relevant "ah-ha" moment for the reader in about 5 seconds. DoD dashboards inside any business unit should be able to quickly answer the most frequently asked (business) questions. If readers are scanning the dashboard for minutes, there's likely unnecessary complications in its design and layout. Senior leaders generally have the final approval on the design of a dashboard. A good practice is designing them with simplicity in mind.

The first, second, and third steps in any dashboard design is problem definition, problem solving, and governance. One of the most insightful and relevant best practices for the design of enterprise dashboards is taken from the world of journalism. Business dashboards and news stories are both trying to tell a story. In the same fashion the presentation of a news story has three key components (header, sub-header, and body), the performance metrics of an organization must be displayed similarly. The top portion of the most effective dashboards have the high-level metrics communicating the general direction of the organization. This is then followed below it by sub-categories of metrics comprising each header metric. Following this is a more robust, drill down capability enabling the sophisticated reader to get into the details if desired. Data governance is an important factor in design so the organization can set the dashboard rules as to who gets the data, when, and whether it adheres to the organizational model.

2. Keep it simple

The most effective dashboards in the private sector only contain 5-9 visualizations on a page. Designers should avoid the urge to fit as much data on the page as possible in the hopes of making every reader happy. One interviewee called this "performance information creep." Tools for automated dashboard

development are used by many leading companies – for example, the green-yellow-orange-red spectrum, where the orange and red have different prescriptive scenarios to get back to green.

The reality is most people, to include senior executives, can process and retain about seven images at any one time.[7] Designing more than 10 items on a dashboard likely means, (a) there's too much information on the page or (b) the dashboard probably needs to be broken down into two pieces following the headers. A best practice in avoiding clutter is to design dashboards with the ability to impose data filters and hierarchies (such as depicting the monthly overhead expense for every DoD installation around the globe and giving the user the ability to filter it by country, state, or city).

3. High flexibility in device, location & access
In their inception, dashboards were created manually, printed on paper, and passed around the conference room table. Now, most dashboards are in the cloud, and most use static data days, weeks, or months old. Leading companies have developed a multi-domain approach to providing dashboard access. The best practices in leading companies is to enable executives and those needing it to access dashboards on their smartphones, tablets, and laptops. One leading company who is extremely far advanced in terms of dashboard development, has even gone so far as to develop their own smartphone/tablet application to enable users to customize their own dashboards based on what their responsibility and interests are. The dashboard is then deployed based on use, location, and security. If DoD wanted to make a step-function improvement in its dashboards, it would mimic this advanced approach. The future in dashboard design is ubiquitous visualization (e.g., phones, tablets, wall mounted, live feed, flat panel monitors in every office).

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7 https://www.simplypsychology.org/short-term-memory.html

Task 5: *Financial statement & transaction level operational data*

> *"Examine how financial statement data and transaction level operational data is used in the private sector and how it could be applied to government (both for senior level decision making and for operational improvement)."*

Private sector best practice today utilizes financial statement data and transaction level operational data in a series of concurrent, integrated processes to (1) maintain near real time legal and regulatory compliance, and (2) drive continuous operating and financial performance improvement.

Regrettably, the DoD has not, until recently, pursued similar practices. The introduction of the Audit requirement and the adoption of the processes required to produce Audited Statements is a potentially transformative event to enable adoption of many business best practices.

It is extremely important to note that, in becoming "data driven organizations," business advances arose through the confluence of four critical factors:
1. Regulatory and legal requirements to create and maintain advanced information control environments or face meaningful financial fines and criminal charges at the Board of Director level. This was initiated through the Sarbanes – Oxley Act of 2002 after a series of massive corporate fraud related failures including Enron and WorldCom. This was subsequently dramatically extended and enhanced after the 2008-2009 global financial crisis (GFC) through the Dodd – Frank Wall Street Reform and Consumer Protection Act of 2010.
2. The emergence of "Digital Transformation" strategies across all value chains and all industry sectors as sensor density exhibits increased, wireless/wired connectivity increased and Data Science emerged to produce actionable ML/AI tools, high connectivity, collaboration and visibility technologies and platforms, process automation and data cleansing tools, and the increasing threat of cyber-warfare from competitors and governments.
3. The emergence and development of new value chain practices and competitive imperatives demanding the use of zero-latency, complexity and uncertainty in operations, speed in decision-making, and the need to base decisions on facts.
4. Management and human capital structures rapidly evolved to optimize and align the physical to digital, digital to digital and physical to digital nature of today's world.

It was the "push" of regulation followed by the "pull" of enhanced performance which brought the commercial world to where it is today.

The Next Stage of managing and using transactional level data to run, innovate and transform the business - Industry 4.0 and Audit 4.0.

The processes and outcomes from 2001 to the present is often referred to as the Industry 3.0 period. Today private industry is in the process of transitioning to "**Industry 4.0.**" It is of paramount interest to note America's pacing competitor, China, has incorporated much of Industry 4.0 practices into their national defense and competitiveness strategies. As a result, we are behind and need to accelerate our progress on a priority basis.

As Industry 4.0 deployed, the enterprise business (and audit) community was challenged to adapt to the massive increase in data, transactions, and information control systems. Interviews informed the TG of the massive changes required to maintain capability in this new environment.

> **The Goal of Industry 4.0:** Enable autonomous decision-making processes, monitor assets and processes in real-time, and enable equally real-time connected value creation networks through early involvement of stakeholders, and vertical and horizontal integration.

While the enterprise is transitioning to Industry 4.0, the Audit function is, in effect, transitioning to Audit 4.0 This transition is illustrated in Figure 1.

The Generations of the Audit			
Audit 1.0	**Audit 2.0**	**Audit 3.0**	**Audit 4.0**
Manual audit Tools: pencils, calculators	IT audit Tools: Excel, CAAT software	Inclusion of Big Data in audit analytics Tools: analytical apps	Semi- and progressive automation of audit Tools: sensors, CPS, IoT/IoS, RFID, GPS

Figure 1: Audit Generations

Audit 4.0 will piggyback on technology promoted by Industry 4.0, especially the Internet of Things (IoT), Internet of Service (IoS), Cyber-Physical Systems (CPS), and smart supply chains and factories, to collect financial and operational information, as well as other audit-related data from an organization and its associated parties. It analyzes, models, and visualizes data in order to discover patterns, identify anomalies, and extract other useful information for the purpose of providing effective, efficient, and real-time assurance. It is typically an overlay of Industry 4.0 business management processes, and uses a similar infrastructure, but for assurance purposes.

Using transactional level data to run, innovate, and transform the business

Private companies use financial statement and transactional data in several ways to obtain insights, drive performance improvements, and achieve major business outcomes. DoD leadership should receive credit for initiating the DoD annual audit in 2018 and for ensuring the organization takes it seriously. Compared with the private sector, the DoD's ability to collect data is well behind the curve, with exception of financial transaction data. The preparation for and execution of the DoD's annual audit has captured tremendous amounts of financial transaction data.

DoD leaders have interest in finding more efficiency in the organization and they know they have a tremendous amount of financial transaction data. As a result, the DoD is interested in understanding what found efficiencies have been possible in the private sector using similar financial data.

Many benefits have been found by global companies as they have begun to analyze financial transaction data. As a general matter industry has focused on:
- Production Process Optimization
- Supply Chain Engineering and Balance sheet optimization
- Customer insight and Market diagnostics for continuous feedback

Below are some of the more typical examples of how this data has been used and what benefits have been found.

Receivables

Organizations in the private sector have begun using financial transaction data related to details around receivables (money owed) to increase payment velocity, decrease probability of default, and recoup owed money. Executives often remain laser focused on topline growth and managing expenses, but with robust financial data, executives in leading organizations are finding automated data analysis of their receivables data can yield:

a) lower customer default rate by matching vendors with data profiles of those likely to default.

b) aggregate receivables across the enterprise by vendor which allows a holistic picture of the partnership value as well as more leverage in future negotiations

c) organize and automate receivable follow-ups (alerts) to vendors at specified times prior to and after payment is/was due.

d) the use of receivables and the credit of the buyer (in this case, the government) to provide supply chain financing to its suppliers when needed.

All organizations, including DoD, have allowances for bad debts and the amount of this allowance can be significant relative to the overall budget. Improving efficiencies in the handling of receivables, even if it only moves the needle by 20-30% can be significant.

Payables

An analysis of financial transaction data related to payables and spend analysis can reveal the spectrum of terms offered and accepted by the organization with each vendor. This analysis can show executives where terms are eroding in favor of the vendors, which often suggest collusion or supplier favoritism by procurement managers.

In addition, spend analysis is used to identify key segments which need an increased level of management and scrutiny.

Inventory

Organizations in the private sector have begun using financial transaction data related to inventory purchases to predict spending, reduce over-ordering, reduce excess and obsolete inventory, identify service levels and availability to the end user (e.g., maintenance, warfighters, supply depots), promote "just-in-time" concepts, return capital to the working fund, re-distribute and rebalance inventory to other locations[8] and, in general, highlight poor inventory management and opportunities for improvement. One of the largest U.S. retailers has seen a significant reduction of excess inventory by coupling on-hand inventory levels with pending purchase orders. Orders placing distribution facilities and retail locations in excess of pre-set inventory par numbers were routed to an exception handling team who contacted the store to validate need.

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[8] https://beenegarter.com/real-time-financial-data-improve-business-performance/

Large U.S. retailers have found the ground level practice of ordering inventory just because items cannot readily be found or are not on the correct shelf, consumes precious working capital. Retailers have begun to use financial transaction data in conjunction with inventory in-stock reports by location to automatically reject purchase orders meeting specific criteria. The end result was a reduction in excess inventory levels and improved balances in the working capital fund.[9]

Large U.S. manufacturers are analyzing patterns and outliers in the expense ratios of different product manufacturing lines. The wisdom of normally standardized data across the historical record of a company can provide valuable insight once the capability of advanced analytics can be leveraged to spot inconsistencies. Working with only financial data associated with manufacturing costs, private sector executives can now be alerted to abnormal expense ratios possibly needing further attention. By knowing and providing the analytical tools with 'normal' expense ratios, this broad application of pattern analysis across almost any set of financial data could be beneficial inside any DoD entity.

Logistics

An analysis of financial transaction data related to logistics and supply chain expenses can reveal directional trends in transportation mode as well as the related expenses to these modes. Leading companies have found these analytics can offer insights to help identify increasingly expensive modes such as ocean, airfreight, rail, or road (full truck loads and partial truck loads), as well as the prevalence of standard to expedited shipping. This, in turn, can identify poor logistics management, potential fraud in contracting, and opportunities for improvement.

Vendors and Acquisitions

Many companies in the private sector use the vast amounts of procurement and acquisition data to manage their sourcing, acquisition, and purchasing functions, some more effectively than others. Many of industry leaders have begun using financial transaction data to develop robust profiles on their vendors and suppliers, predict supply assurance, risks and performance.

For procurement departments, information is power. Insights gleaned from historical data on product pricing, vendor performance, terms, and vendors can strengthen the buyer's negotiating position, change sourcing and acquisition strategies and drive better pricing and terms. To provide some context on the potential pricing benefit for an organization, implementations of advanced analytics in the procurement departments of some leading companies have achieved cost savings of 3 to 8 percent, compared to traditional pricing models. In 2017, DoD allocated $320B in federal contracts and 51% (or $163B) was spent on 'products/goods' while 41% was spent on services and 8% went to R&D[10]. Applying this rate of savings to DoD's $163B yields a rough estimate for potentially $5B to $13B in savings. Employing analytics on procurement financial data can uncover new insights for negotiations, vendor segmentation, vendor performance management, and annual purchasing strategy.[11]

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[9] https://channels.theinnovationenterprise.com/articles/how-big-data-is-improving-inventory-management-across-industries
[10] https://fas.org/sgp/crs/natsec/R44010.pdf
[11] https://www.mckinsey.com/business-functions/operations/our-insights/the-era-of-advanced-analytics-in-procurement-has-begun

Within large organizations a significant amount of the capital is allocated for purchasing raw materials or wholesale products for resale. Leading companies have found by aggregating all buy and sell activities with its vendors (or suppliers) on a global and category basis, they have better information when making decisions. Total spend and spend trajectory analysis can provide valuable insights at any time in a vendor/supplier relationship, but no more so than during contract renewals. In one case, a large manufacturing company with disaggregated purchase authorizations found its retail, warehouse, and distribution facilities around the country were all making purchases from a single vendor, but at widely varied pricing. This analysis of purchase activity across vendors and suppliers is an inexpensive form of category management analysis that can yield massive savings on commodities and services bought across an organization. In addition, data from suppliers on product sources and Bills of Material can lead valuable information on the true source of products – whether they come from unstable regions or potentially hostile countries. It must be remembered, at a strategic level, the real benefits arise from supply assurance and risk management.

The Customer Experience

While much of the focus of data is on the extended supply chain, a critical aspect for private companies is the analysis of their customers. Companies (and the DoD) have multiple customers along the chain to include supply depots, end consumer/warfighter, and support. Analysis of financial and operational data provides the real needs, and performance to those needs, of the customers. The Voice of the Customer drives dashboard designs, and the priorities, strategies and execution of the supply chain and central logistics agencies – in terms of packaging, delivery, availability, paperwork and identification of product, and notice of inventory status, consumption and incoming shipments.

People

Leading companies use their transaction data to look at tangible assets and liabilities; however, they also use them to monitor critical people-related issues, such as the hiring pipeline for different levels and skillsets, speed and efficiency of the hiring process, hiring, retirement and firing numbers, people positions and processes by various organizations, compensation and fully-loaded compensation. In leading organizations, people management and development is not a function left to the HR department. As people are the most important asset in any organization, and talent and skillsets are the differentiator in today's competitive battlefield, this becomes as important as the management of assets.

Task 6: Analogous, world class private sector examples

"Share/explain analogous, world class private sector examples."

Most major U.S. companies are placing big bets on data and analytics. However, adjusting to the era of data driven decision making is not easy for organizations or their leadership. Many of these companies have difficulty adjusting to the new era of technology-driven change and new information-intensive business imperatives while changing company culture, talent management and recruiting, and adjusting business and decision-making processes to manage data, and develop and seize value from their analytics. Although it is a journey that can take years and significant people and capital resources, some leading companies have accomplished this difficult task and it has produced significant benefits.

Below are four case studies on major U.S. companies which have gone through the journey of digital transformation and data analytics. These companies have similar characteristics to the DoD in that (a) they are among the largest global companies, (b) face somewhat similar challenges, (c) have diverse business units and operations. and (d) achieve benefits applicable to those needed by the DoD.

Case Study #1: A large, multinational conglomerate[12] with multiple and autonomous Business Units:

Background and Current State

This company is an extremely large conglomerate growing both organically and through several acquisitions, and maintains multiple and different autonomous and large business units across the globe. The senior management understood, in the new uncertain and technologically-driven environment, it required the effective use of data and analytics to run the business and innovate. This was a major revelation for a company known for its measurement and analytics systems. As a result, they brought on board a CDO as the lead CDO of the world-wide operations with responsibility for leading the company's financial data platforms and full responsibility for Sarbanes Oxley Act (SOX) audit requirements[13] and ensuring the data is correct after it comes out of the audit. The CDO's success was measured by data accuracy, completeness, and the effectiveness of data analytics at every level in the organization.

Addressing the Problem and Designing the system

As a first step towards ensuring clean and consistent data from across the enterprise (a single source of truth), the company undertook a major effort to harmonize and reduce the number of their ERP systems. It took 6 years to move from over 600 different systems down to 32. During the journey, the company found they had 42 massive data warehouses and the average data query performed by most users had to touch 8 different systems to return results. At the time of the interview the company executives estimated they still have 15-20% of the job left to do.

The acquisition strategy and autonomous nature of the business units has resulted in a large number of legacy and customized systems whose owners were reluctant to change or give them

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[12] This company requested their identity not be disclosed in the study.

[13] The Sarbanes Oxley Act requires all financial reports to include an Internal Controls Report. This shows that a company's financial data are accurate (within 5% variance) and adequate controls are in place to safeguard financial data. Year-end financial disclosure reports are also a requirement. An independent external SOX auditor is required to review controls, policies, and procedures during a Section 404 audit.

up because it was what they had conceived, developed, and understood. As a result, when the initiative to begin collecting, cleaning, and organizing data was announced, the CDO was very careful to announce he would not be killing off any existing data platforms. This bought him the acceptance of the various system stakeholders and the freedom to begin building their new global platform.

The Chief Financial Officer (CFO), while recognizing the value of this strategic initiative for the business, gave the CDO some clear conditions on how it would go forward and be funded: (1) The project and its funding was to be treated a venture funded start-up with milestones and gates which must be hit in order to continue future funding, and (2) the project would need to benchmark current expense and overhead rate of the existing data architecture and use this as a baseline to measure and communicate return on investment (ROI) in terms of business growth, achieving strategic objectives and expense reduction as the project matured over time. It was understood the project would not have any returns for the first year.

The next and critical step was to obtain executive leadership support across the organization. The CDO conducted a workshop where the senior leadership team was asked to agree on the purpose of this project. The question posed to them was: 'Are we building an analytical platform for the senior executives OR an operational platform to run the business?' The answer from the leadership team was unanimous - the purpose of this new project, system, and platform was to help them run the business operations. They viewed the analytical insights as a supplemental benefit to help drive continuous improvement inside the enterprise.

The project team was very careful to involve all the business units in the design process to ensure they felt a degree of ownership and familiarity in the platform. Two important aspects of the design process were to get the requirements first from the "frontline" field operators and managers, then the executives, and recognize the various BUs had different business needs from those of senior corporate leadership, and incorporate this into the design.

Building the Team
The CDO recognized the organization did not have the right skill-sets to either design or execute this transformation. As a result, 76% of the core project team was populated from people brought in from the outside of the company. 80% of these external hires were people who had thought leadership, functional and domain expertise, with hands-on responsibilities. The remainder were analytical experts with less technical background. Internal hires to the core project team were high-performers with a strong familiarity for how the enterprise worked. As the initiative progressed, the data and analytics expertise was distributed between the BUs and the corporate team (which essentially worked as a CoE). One of the responsibilities of the Corporate CoE was to provide training and support to the BUs.

Change and Implementation
Employees and leaders across the organization, generally accepted the fact an advanced data management platform initiative could bring significant benefit and efficiencies to the global organization. However, there was still a lack of appreciation across the enterprise in terms of what the end-state would look like and how this initiative was mission-critical. Hence they were not initially willing to give it the priority and support necessary. Additionally, senior BU leadership

perceived having to 'give up' full control of their data and share it could somehow result in a loss of control and resource allocation reductions.

The CDO overcame this objection and obtained senior leadership support by clearly articulating the end-state, tying it directly to corporate and business unit goals, and describing the real value in terms of goals – growth, effectiveness and cost reduction – through the life of the initiative. The goal was "define the end state and shoot high." This was achieved through a cross-BU, cross-functional series of design workshops droving joint design and general acceptance through the organization.

The project began the effort to start collecting, digitizing, and cleaning data at the lowest level - the "front line." This often meant the project teams would be visiting the front line workers on manufacturing plants, warehouses, testing facilities, loading docks, etc. Their initial effort involved establishing common definitions and calculations for data fields that would be the same across all business units and functions (e.g., the fully-loaded hourly cost of a full-time employee and the definition of on-time delivery to contract). This initial phase focused on common data across the BUs.

The next step was to begin designing analytics to help front line workers measure success and goal progress. The project mantra was to focus first on the trenches and then work their way up the organization as they built a strong and reliable foundation of clean data.

The plan was to start with the "friendliest" business units and focus on collecting data from their account payable (AP) systems. This plan would expand to collect from all AP system across all business units. The team spent time developing the change management approach. It put together a presentation and vision, with benefits relating directly to business and operational outcomes, and defined to the operational people – the "art of the possible," and "what does good look like." It included involvement and collaboration with the BUs, a communication plan, incentives, with senior leadership communicating their top-level commitment and sponsorship, and a mandate from the CEO stating he would use this data as the basis for his management and decisions.

Data Governance
This global conglomerate had dozens of massive, different, and autonomous business units spread across the globe and the proprietary data systems inside each of those different business units were designed in silos. This separation and lack of data consistency created a critical need for data accuracy and integrity coming only from an enforceable data governance policy.

In the corporate world, the SOX requires company leaders must certify data is accurate, under the threat of criminal penalties. This well-known mandate provided the CDO with the ability to insert his team to help business units collect, clean, and organize their data to help [the leaders] avoid criminal penalties. The business unit leaders own the data and are responsible for accuracy and completeness. This, in turn, is driven down the organization where the people who originate the data are accountable for its accuracy and completeness.

The dashboards are interactive, intuitive, and focused on effective decision making – but mainly descriptive and, to some extent, predictive, at this stage. The executives and "front-line" managers can customize them for their own specific uses. The CDO and senior leadership see the major benefits coming from the ability to connect the dots across all functions and BUs, include external data, and move to prescriptive analytics ("intelligent algorithms"). Despite the impressive results, the CDO still believes the company is in the "Walk" stage with a great deal yet to be accomplished on the journey.

One result of this company's effort is highlighted below:

> *When asked, this company said that within just a few minutes, it could provide a comprehensive report on the quantity and status of the many contracts it has with DoD and other government agencies. How long would it take the DoD to do the same in connection with its contractors?*

Case Study #2: Proctor & Gamble

Background
Procter & Gamble Co. (P&G) engages in the provision of branded consumer packaged goods. The company has multiple global and national brands and business units.

P&G, from an operations standpoint, has a massive footprint. To be successful, they believed they had to continue to improve productivity, and do more with less capital. The senior executives were unanimous in the agreement a digitally enabled organization would allow them to do that. P&G decided to introduce technology and advanced analytics to every aspect of P&G operations and activities, ranging from manufacturing to supplier management, including at the detailed operations level – for example, from the front lines of each manufacturing plant to the loading docks where their products moved every day. The goal for the executive team was to improve productivity, reduce costs, and react more quickly to changing market demand. They understood, if well-executed, the digitization of even the most routine of the operations could provide the ingredients for advanced analytics which would yield competitive advantage in their markets.

Design & Implementation
In the P&G manufacturing plants, they implemented systems and apps allowing employees to use iPads to download data off of the production line in real time and communicate data to an analytics team where it is reviewed for quality and tolerances.

With such a large enterprise and so many locations and functional sources of data, P&G has still not yet digitized everything. However, they envision a system where managers, using their mobile device tablet or laptop, could see any product at any moment as it goes through the manufacturing line of one of the plants. One of the executives suggested the next step even beyond that was to also see the cost of products moving through the supply chain at any one time. Each time the product changes hands or transportation method, additional costs are incurred. One of the challenges they realized in contemplating this problem was due to the fact

accounting systems are not designed to integrate with operations systems. Accounting systems tend to look backwards but best in class manufacturing operations design their operational systems to look forward, and be more predictive in terms of product demand. They identified an opportunity where their financial data might be reframed to develop more forward leaning metrics.

In transportation and logistics, P&G created an operations construct called the Control Tower, which lets them see all of the transportation being used at one time; inbound, outbound, raw materials, and finished product. For example, as one of the largest users of trucks in the U.S., they were able to reduce the amount of dead-space present in its trucks through this new application as they move from point to point. Overall reduction in dead space was 15%, which was a significant expense reduction given the size of their logistical footprint. Once it had developed this analytical capability with its own logistics data, P&G reached out to its vendors and suppliers and offered to help, at no cost, to analyze the data related to the movement of P&G products. This improved efficiencies for both the vendor supplier companies and it enabled P&G to develop a broader and deeper data picture of its inventory and where it was at any one moment in the supply chain.

Dashboard Development
In one of the most interesting technological outcomes from their digital transformation, P&G developed software allowing their executives at any level in the company to customize dashboards for themselves. The P&G team calls this customizable dashboard app their 'cockpit' and users can put it on their smartphones, tablets or laptops. The users are given the ability to customize which performance metrics, lines of business, etc., that interests them. The app also enables the user to set certain alerts when the performance of a certain metric hits a specific tolerance. Users can then click down into the data to determine causality of the pattern change. P&G sees this time compression, or ability to react more in the present, as a competitive advantage enabling them to adapt.

Every Monday morning, the entire global P&G leadership team, physically or virtually meet to review the business for the previous week as well as predictive metrics for the future periods. They are able to click down on the data and investigate anything requiring attention. All P&G executives must buy into the principle behind its focus on real-time data. The feed of quality data is continuous and it gives P&G the ability to find causality, and most importantly, make decisions with greater accuracy and timeliness.

Data Integrity
As P&G began to apply these principles over time they recognized their greatest challenge was with the data sources. Data collected on a weekly or perhaps biweekly basis cannot be coupled with actual, daily real-time data because it distorts the timeliness and accuracy of the data. P&G realized they needed to work more closely with all the data sources to increase the frequency of collection.

P&G began to change the way they measure the quality of relationships with vendors by evaluating the quality and quantity of the data shared by external vendors and service providers. Sharing data with P&G is not mandatory but it is encouraged to ensure mutual success. Obtaining

data from vendor systems on the delivery of a service or inventory levels helped add greater depth to the analysis.

Talent and Up-skilling

As P&G went through the journey of improving its data they realized their constant challenge would be maintaining the talent and skill sets required to manage the data as well as the cutting edge tools seeming to evolve every 18 months. They developed a baseline digital skills training tailored to operations at every level of the organization. This would ensure, should an employee be asked to work in a particular area of the organization and had gone through this training, they would be competent in the native analytical systems and tools. P&G set up the same expectations for senior managers and established an area in the same facility where trainers work privately with senior executives to bring them up to speed but not embarrass anyone.

Case Study #3: Walmart

Background

Walmart Inc.[14],[15] engages in retail and wholesale business. At present, it is the largest brick and mortar retailer in the world, with approximately 11,500 stores under 56 banners in 27 countries and e-commerce websites in ten countries. The company employs more than 2.2 million associates around the world, and nearly 1.5 million in the U.S. alone. It operates through the following business segments: Walmart U.S., Walmart International, and Sam's Club.

With this large and diverse footprint, Walmart has huge amounts of data at its fingertips as well as the resources to collect and analyze the data. The most important lesson any large organization can take from a study of Walmart's use of data is their ability to react to data quickly. There is no reason to invest valuable capital in developing analytics if capital isn't used first to collect, clean, and organize the data. Data analytics capabilities mean nothing if your data infrastructure and governance model doesn't allow you to quickly make decisions and changes based on what the data is telling you.

Digital transformation

Walmart took a major step in its digital transformation in 2012 when it made a massive investment in its data infrastructure. The main objective of this upgrade was to position the company for an exponential increase in e-commerce. The team took the incoming data from ten different company e-commerce websites and brought them into a single website so all unstructured data generated was collected into a single data source.

Once the 2012 digital infrastructure changes were completed, the company moved quickly to embrace big data analysis and provide the best-in-class e-commerce customer experience. The main objective of leveraging big data at Walmart is to optimize the shopping experience of customers. Big data solutions at Walmart are developed with the intent of redesigning global

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[14] https://www.sas.com/en_us/insights/articles/analytics/how-walmart-makes-data-work-for-its-customers.html.

[15] https://corporate.walmart.com/newsroom/innovation/20170807/5-ways-walmart-uses-big-data-to-help-customers.

websites and building innovative applications to customize shopping experience for customers while increasing logistics efficiency.

Center of Excellence

The company is in the process of building the world's largest private cloud. This cloud platform will be big enough to cope with 2.5 petabytes of data every hour. To process all this data and house the talent needed to manage it, Walmart established a CoE called its 'Data Café.' This CoE is a state-of-the-art analytics hub located within its Bentonville, Arkansas headquarters. This hub works to reinforce the data driven culture by not only providing centralized analysis but pushing out governance models for standard analytics.

The Data Café pulls information from 200 varied sources including telecom data, social media data, economic data, meteorological data, Nielsen rating data, gas price data, and local events databases. The Walmart analytics team asserts using this broad array of data they can find patterns and develop solutions to address almost any challenge. The company's analytic algorithms are designed to scan through these various data sets in seconds to develop patterns and offer solutions to real-time problems.

Data and Infrastructure

Company executives place data integrity at the top of the priority list. Walmart collects multi-terabytes of new data *each day.* Combined with the petabytes of historical data (covering billions of financial transactions, millions of products, and hundreds of millions of customers around the world), this is a tremendous amount of data. The data generated by Walmart every hour is equivalent to 167 times the books held in America's Library of Congress. The data is so large it would be impossible to leverage it to help find internal efficiencies without having the proper underlying infrastructure. Walmart ensures its data is captured in digital format and immediately pushed to where it can be collected, cleaned and organized.

Talent and Upskilling

Walmart executives realized the growth of its analytical need and shortage of analytics talent could limit the company's potential. The company created a team, known inside the corporate headquarters as the Big Fast Data (team), which helps data users, including developers, data scientists, and business analysts use the data effectively to make decisions. The team helps business units acquire data, develop and operate data feeds, analytical tools and implement the infrastructure.

The demand for big data analytics inside the company is increasing not only because the business has grown, but because nearly every business unit and functional areas is heavily relying on advanced analytics for continuous improvements. Similar to other leading companies, the lack of data analytics talent continues to be a major obstacle for Walmart. With limited supply of employees who have the required data analytics skills, Walmart is taking steps to ensure it is able to compete for talent in the marketplace; one involving the creation of recruiting techniques and searching for analytical talent in non-traditional candidates (e.g., including physics majors with no formal analytics background versus strictly recruiting data science majors). Additionally, new employees are required to spend time in a rotation exposing them to the analytics team and the work they do to help business units across the enterprise.

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Accessing Data

The company's data culture underscores the importance of data and its competitive advantage. Having spent so much effort and resources ensuring data quality, executives pushed hard to make the data available across the organization. The realization being good, clean data has little value if it is not available for analytics.

Business units freely offer their data feeds as a routine function of daily business operations. Unless doing so involved sensitive customer information, not sharing data across the enterprise would be highly unusual. Walmart executives refer to their data access model as a Big Data Democracy. They work hard to remove any kind of data bureaucracy related approval steps for pushing or accessing data. For users, it only takes a day or so to get access to the data and various analytical tools. Sharing data deeds with the corporate headquarters is an expectation with no alternative options.

Designing the Analytics

The Big Fast Data team utilizes a wide range of analytical tools from a variety of vendors, open source, and in-house developers. The team began with an enterprise data warehouse and built an infrastructure for the data. This platform enabled the use of multiple business intelligence and analytic tools. By having many different flavors of analytical tools, the team was able to hire talent regardless of their variation in skill-sets or platform expertise. The team brings in people with diverse skill sets which has resulted in much more creative solutions.

Using the Data

Walmart views its data as a valuable asset which can and should be used to (a) drive internal efficiencies, (b) grow revenue, and (c) improve customer experiences. The company has a vast archive of data to create historical perspective and also collects a tremendous amount of data on a daily basis.

In 2013, Walmart acquired a small startup called Inkiru based in Palo Alto, California to boost its big data capabilities. Inkiru's capabilities augmented Walmart's approach to targeted marketing, merchandising analytics, and fraud prevention. In particular, Inkiru's predictive technology platform pulled data from diverse sources both inside and outside of Walmart's universe and bolstered Walmart's ability to personalize the customer experience through data analytics. The predictive analytics use by this platform incorporates ML capabilities. Walmart executives knew they needed the big data and predictive capability, and they had enough capital, so rather than build it inside from scratch, they just bought the capability and essential outsourced it to a new division inside their enterprise.

Analysts on this team are famous for identifying the hard to explain customer purchase pattern preceding hurricanes. The predictive analytical tools used by Walmart's team once suggested, among the normal assortment of products purchased by customers before a hurricane (such as flashlights, water, batteries, etc.), customers also bought multiple boxes of strawberry Pop-Tarts®. In fact, sales on this particular product increased by seven times before a hurricane. This insight, while unusual was seen as a potential missed revenue opportunity and the company increased its inventory and pushed the product to the front check-out lines before each

hurricane. As imagined, the revenue boost for that product line was significant after the operations team received the actionable data. However, the behind-the-scenes manufacturing, logistics, and operational movements required to get more of the product in place (and in time) takes a lot of planning and preparation. Good data and predictive analytics can help identify opportunities like this throughout any enterprise.

Driving Internal Efficiencies

Given the massive footprint of Walmart's logistical operation, applying analytics to the operational data collected from the field is a natural extension of the capability. One of the most meaningful ways Walmart has been able to utilize its data analytics teams was to orient them towards logistical efficiencies. External real-time data was brought in from multiple sources, most significantly including real-time weather changes. Weather significantly affects customer retail behavior ranging from which products they buy to whether or not they leave the house. These changing behaviors can be predicted using past weather events and comparing them with past sales history. From this analysis, specific recommendations can be made to business units about staffing deployment in certain retail markets, impulse products presented at checkout or perhaps the movement or ordering of inventory.

The inventory management team at Walmart uses predictive analytics heavily to augment and support decisions made by supply chain executives. These efforts help reduce overstock and stay properly stocked on the most in-demand products. Walmart's vendors are required to use the real-time vendor inventory management system helping minimize the inventory for a particular product if sales are relatively low. This helps the company conserve capital and allocate it to other areas with increasing demand.

Grow Revenue

The analytics team maps trends and patterns within the sales history of millions of items and alerts business units to anomalies which may indicate a manual error has occurred at a retail location (such as items not being priced correctly, items stuck in a backroom, items displayed on the wrong shelf, etc.). By drilling into the data, the team is quickly able to diagnose problems that can be corrected within only days rather than months thereby reducing the risk of revenue loss.

The automated analytics also provide automated alerts, so, when particular metrics fall below a set threshold in any department, the relevant team is alerted so they can find a fast solution. For example, during a holiday season, the automated alerts suggested an anomaly at only two out of hundreds of similar stores. A popular holiday food item showing robust sales in every store in the chain showed no sales at these two stores. The automated alert went out and within hours, the business unit found the problem was due to a simple stocking oversight, the food item was never taken off the loading dock to put on the shelves. Walmart has found this use of real-time information is applicable to all different kinds of transactions, including those far from the customer facing interactions.

Small adjustments to the customer experience can translate into significant impacts to the bottom line, especially with the volume of transactions Walmart sees each day. To track the impact of these changes, analysts compared similar periods of sales history before and after changes were made. It is not uncommon for analytical recommendations to the e-commerce

platforms to result in 10-15% revenue increases (or $1B in incremental revenue) in the given time period.

Improve Customer Experiences

One of the ways Walmart improves customer experience is by using data mining tools to review historical purchase activity across millions of customers and hundreds of millions of transactions, and provide real-time recommendations for customer currently shopping Walmart e-commerce platforms. This use of data mining has both improved revenues and created a better shopping experience which is measured by a higher conversion rate of its online customers.

Walmart wants to intimately understand its customers and as a result, tracks each consumer individually. With customer data on over 145 million adults, Walmart records browsing and purchase activity, residential address, and the places they visit inside the store. Store data is tracked through in-store WiFi activity. The big fast data team at Walmart performs analytics on each action occurring on their online platform to include what consumers buy in-store and online, Twitter product trends, and winners of major sporting events.

Walmart is leaning forward into customer facing predictive analytics. They envision a future where a suggested shopping list is pushed to a customer's smart phone once they enter the store. This effort uses the existing technology of geofencing and gives the company the power of big data analysis is by leveraging analytics in real-time. The geofencing feature of Walmart's mobile app senses whenever a user enters the Walmart store in the U.S. The mobile Walmart app invites the consumer to switch the app into 'Store Mode.' The store mode of the mobile app helps users to scan quick response (QR) codes for special discounts and offers on products they would like to buy.

Case Study # 4: **Global Professional Services Firm**[16]**: Driving from "Good to Great" through Analytics, Data and Metrics**

This firm consisted of many semi-independent (owing to country laws) firms all linked together in a common partnership. As such it had multiple cultures, business environments, laws, rules, and expectations. It was faced with the challenge of improving its performance against powerful competitors. They realized the current way of doing things was not going to do this and, in fact, hindered them. A critical issue across their global enterprise was employees found their performance measures vague, lofty, and not actionable at their levels. As a result, the company revamped their performance metrics and the analytics supporting them.

- **Their first Step: Diverse Leadership team jointly set goals and key metrics:** The CEO met with all the global senior leadership in one set of sessions, jointly set key goals in terms of their competitive imperatives such as: being the best, best place for people to work (hire and retain the best), do high quality work, and grow revenues and profitability. While the cultures were different, the objectives were the same. They then took these all the way to the BU and individual performance measurement across the globe. The metrics were built it into the regional/BU heads' performance metrics, and driven lower down in the organization to the

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[16] This company requested that their identity not be disclosed in this study.

junior levels. Essentially, they developed the specific metrics needed to drive behavior and change. This removed much of the pointless reporting and focused on what mattered.

- **Next: they evaluated their analytics** – The cross-functional, cross-unit analytics design team started by asking the basic question: "what problems are we trying to solve," and "what do we want to analyze," Once they had answered these, and stress tested it with all the member countries and leadership, they them made it the focus of the leadership team. The analytics were based on the goals, the risks, and were descriptive and predictive.

- **Data Accuracy, Completeness, and "Organization-wide" Trust:** The challenge was getting clean and believable data. This was the focus of much of their attention to start with – getting clean, "single source of the truth" data everyone agreed with. This involved the appointment of a CDO, a "data lake" strategy, mandates about data entry, ownership (at all levels, with the Country/Region Managing Partners responsible) and use. They then they acted on the data in terms of individual, BU and regional performance, and communicated this action throughout the organization.

- **A Change Management-driven Implementation Program**: The firm had all the diverse, multi-country/multi-BU leadership aligned to this through a comprehensive change management program which included BU involvement and collaboration, senior leadership mandate and communication, with completely open actions intended to show the senior leadership were serious about this change and the outcomes.

- **The Results:** The journey took several years, is still in progress, and the firm achieved its clearly-stated goals of revenues and profitability growth, employee satisfaction, hiring and retention, skills acquisition.

Key Take-Aways:

These case studies highlight and illustrate several key learnings:
- Effective strategy and implementation must be top-down.
- Organizational leadership must buy in, to the program, its strategic and operational value, and contribute to the design of the metrics and analytics.
- Centers of Excellence are important as "scarce resource" centers, thought leadership, advanced development, collaboration, education and dissemination of leading practices.
- Focus on the business areas that count and use big data and analytics to drive strategic business results.
- Focus on the data, a "single source of truth," a straight link to the performance management system, and the implementation of a comprehensive change management program.
- Address both the "front-line" data and analytical needs, as well as those of the executives.
- Cross-organizational and external data to develop actionable insights.
- Business recognition that the "back office" is critical to the sustained success of the front line.

We have incorporated these into our Recommendations.

Task 7: Unique characteristics of the public sector

"Explain unique characteristics of the public sector that may limit or hinder application of private sector best practices and provide mitigation strategies, as appropriate."

The DBB interviewed several public sector thought leaders as well as academics at some of the country's leading universities. Listed below are some of their insights. The general theme was the public sector has several fairly unique characteristics which could hinder the implementation of leading practices from the private sector.

Among the more important of these are:

1. Goals and Objectives. The Public Sector does not have a single bottom line and no single underlying set of metrics (such as profitability or share or growth). Additionally, public sector organizations often have multiple and competing goals. The private sector, on the other hand, has unambiguous goals that do not have to change every 2-4 years. The private and public sector do have a shared goal of controlling cost**.** In addition, unlike China, the U.S. does not have a comprehensive strategic plan focusing on desired outcomes.

2. Nature of Responsibility and Accountability. The public sector is a monopoly not facing traditional 'competition' which typically prompts the drive for either innovation or continuous improvement. The public sector also tends to be hierarchical, process oriented, and risk averse. In addition, the performance measurement and reward systems typically do not provide adequate information and incentives to reward top performers and hold non-performers accountable.

3. Hiring and people processes. The culture of working in the government is significantly different than working in the private sector and the gap continues to widen. Workers in the public sector are rewarded for longevity versus performance. Accordingly, these employees usually stay in their jobs for long periods of time, in many cases 30+ years. In contrast, private sector employees are much more apt to change jobs every few years, advancing positions or expanding their skill sets with every move. The public sector is much slower at hiring new people and removing poor performers. The compensation systems are perceived as different between the public sector and the private sector. The hiring managers in the public sector do not do a good job of articulating this. Unlike the leading edge companies, the public sector insists on fixed office locations without the options for individuals working remotely. Compensation is based on individual performance in the private sector, but not in public sector.

4. The Public sector has a fear of holding people accountable. Too many people are jointly responsible and participate in decisions - decision by committee - which ultimately means no one is accountable. Performance management systems do not result in meaningful distinctions in the level of performance between individuals and, as a result, do not provide an adequate basis for rewarding top performers and dealing with poor performers. Furthermore, unions and agencies tend to protect the few 'bad apples.'

5. Senior Leadership in the Private Sector have flexibility and direct authority. In leading private sector companies, it's clear who is in charge. In the public sector, there are multiple people who

say/claim they have control over the outcomes. For example, while the SecDef is the leader of DoD, most of OSD's component heads are Presidentially Appointed, Senate-Confirmed (PAS) officials, as are the Service Secretaries and Chiefs, who all serve at the pleasure of the President. Obviously, the sheer size of DoD plays a role in this, but it is really a core issue, and one particularly important in the area of data and analytics

These public sector characteristics pose significant challenges to developing and implementing an effective 'whole of government" data and analytics strategy. The Task Group, based on the interviews with senior DoD executives and our own observations, believes that these can be overcome through policy and structural changes, combined with communication of the "burning platform" and the potential consequences, and the implementation of a comprehensive change management program.

Task 8: Reporting financial statement and transaction level data to inform decisions

"Provide specific recommendations and options for the presentation, periodicity, and organizational level of reporting financial statement and transaction level data to inform decisions."

Analytics and the effective presentation of data and insights are critical components of data-driven decision-making and the journey of digital transformation. However, the first step in this journey is the cleansing, organization, and standardization of data across the organization, enabled by tools, sharing and change management. This is a necessary first step before data can be presented or analyzed for optimal decisions. The TG feels it's necessary to mention this because it was a common theme in private sector interviews. Several executives in private industry pointed out the pitfall of getting easily enamored by the concepts of dashboards, control towers, visualization and interactive capability, and losing sight of the basics – data.

That aside, the TG has identified several leading practices in the private and public sectors dealing with analytics to drive informed decisions.

Recommendations/options for presentation of information and insights
In the private sector, the basic and most effective presentation of analytical insights are accomplished by dashboards. As the quality and completeness of the data improves, there are several dashboard design rules leading companies follow. These include:
- Following a measured design process using a series of questions to map out the questions being answered, the decisions being made and the information necessary to make decisions.
- Designing in collaboration with the users (whether at the "front line" operational or the senior executive level), and using thought leaders to provide a holistic, long view to the design process.
- Starting small, using data that is certified complete and accurate, and develop analytics based on that, and move up in scope, impact and complexity as data improves.
- Ensuring balance between the right information vs. information overload. Dashboards should focus on the vital few key performance indicators.

Understanding that while an organization may have hundreds of metrics, there should be only a small number of powerful and insightful KPIs. One of the leading companies interviewed strongly suggested there should be approximately from 5-9 on a dashboard.

Using Dashboards
Interviews with senior executives and thought leaders from across the spectrum revealed some interesting and impactful insights into the use, categorization, types, and progression of dashboards and analytics (see Figure 2). These will be of high impact, applicable, and necessary for the DoD in their digital transformation journey.

Type	Focus/Target Audience Users	Periodicity	Types of KPIs/Data – Basic Examples	Types of KPIs/Data – Advanced Examples	Desc	Predictive	Prescriptive
Strategic	Enterprise and BU/Unit National Defense Strategy	Monthly, Weekly, Daily	Enterprise – performance, operational, cost, program risks, resource allocation, project & program costs, People, numbers, compensation	Major Accounts performance; Skill sets & hiring; Overall project & program performance and impacts Resource Allocation	What happened yesterday and today? Facts Analysis	What will happen and impacts given current trends and other factors – internal/local, other organizations, external "What-if"/ interactive options	What should we do given the data and trends? What are our options? "What-if"/ interactive options
Operational	BU /Unit Functions Major Project & Programs	Monthly, Weekly, Daily, Real-Time	BUs – performance, Cash, costs, Functional – costs, service; functional performance Risks, Program and project costs Supplier performance People, numbers, compensation, hiring,	Major customers/User groups performance; Logistics costs and breakdowns; mega-process performance; Acquisition Costs; Skillsets, training; Supplier capability; Program and project progress; LOBs, completions, impacts			
Tactical	Local	Daily, Real-time	Inventory status, consumption, location To be delivered; local performance	orders, in transit, ageing, performance, costs, quality of goods			
Data Sources			Transactional – local, organizational, functional	Transactional – cross-organizational, cross-functional, external			

Figure 2: Dashboard Types

There are several different constructs companies are using to segregate categories of information and design dashboards that fall into 3 major perspectives.

Category

The TG believes three categories cover the necessary requirements: Strategic, Operational, and Tactical *(Companies use between 2 to 4 categories, depending on the degree of granularity they seek).*

A *strategic dashboard* depicts the progress towards reaching an organization's major, usually (but not always) long-term goals. These visualizations, aggregate enterprise-wide data, and many of the metrics and analytics are similar to the Operational BU and functional-level dashboards.

DoD's strategic dashboard metrics would all map neatly back to an NDS pillar, while the Services' dashboards would relate to the NDS goals, cost goals and their own readiness and material goals.

An *operational dashboard* depicts the status, performance, and trends of a business unit's operational performance and a function's performance. The KPIs must track and match to the NDS goals.

> *The primary purpose of a dashboard is not to inform, and it is not to educate. The primary purpose is to drive action!" –Google executive*

A *tactical dashboard* typically resides at the local operational level of an organization and facilitates the management of tactical/field activities changes and initiatives. The KPIs must track and match to BU, functional, and national goals.

Recommendations/options for reporting at organizational layers: The three different types of dashboard categories all have natural fits within an organization:
- **Strategic** level dashboards- enterprise/OSD/Service heads and, in many instances, BU/Service leadership.
- **Operational** dashboards at the BU/Service/functional/Program Leadership and mid-manager levels.
- **Tactical** dashboards at the mid-management and operator/field-level of the organization.

Types of Analytics:
- *Descriptive* (the ability to connect the dots across all functions and orgs, and draw conclusions).
- *Predictive* and *Prescriptive* (intelligent algorithms).

The **periodicity** of reporting ranges from monthly, weekly, daily, and real-time. The level, scope, and complexity obviously increases from the tactical to the strategic.

Measurement Frequency in collecting and reporting data:
The frequency of measuring a KPI depends on its characteristics, including how often its related information changes or is collected. Most organizations the TG spoke with struggle with the process of collecting data and organizing it into a single source of truth captured and updated in real-time. While this is the ideal scenario for data and conditions changing on a continuous basis, much of operational data is collected at regular intervals, such as daily, weekly, and monthly.

Determining the right frequency of data in an organization's dashboards is dependent on clock-speed – the frequency the metric must be monitored and updated, the quality and frequency of the raw data from the originating business unit, and the degree of change – the frequency with which relevant events change. Hence, there is no one single answer, but these factors need to be considered and analyzed. Executives expressed the danger is the collection of too much data and the desire to collect certain data in real-time – when that is not appropriate or necessary.

A review of the best practices inside the private sector found many top companies had invested in automated collection of business unit data and were moving to a cloud platform. The **recommendation on periodicity** for reporting data is the lowest latency and granularity necessary and available. If it is decided more frequent periodicity for a particular KPI or program is needed, then initiatives must be launched to increase the accuracy and frequency of data collection.

Dashboard Design Matrix:

The TG has rationalized and combined these different categories and types, and summarized its findings into the simpler, easier to comprehend matrix model shown previously in Figure 2 Leading companies start small ("walk before running") with their available data set (data which is certified, accurate, complete), moving from "basic" to "advanced," and from "descriptive" to "predictive," incorporating higher levels of data, including cross-organizational correlational analysis. Moving to the more advanced levels of "predictive" and "prescriptive" requires advanced algorithms, AI, and ML.

Task 9: Recommendations & options for additional reform

> *"To provide specific recommendations and options for additional reform, to include tools and/or modifications to existing decision processes."*

TG interviews and research show there are a large number of tools available through the process and use cycle, from data cleansing and standardization, to process development, standardization, analytics and algorithm development and visualization.

However, the timeframe of this project did not allow the TG to delve deep into the applicable tools or to analyze the relevant DoD processes in detail.

The necessity of rigorous, standardized methods and process for technology and systems acquisition. The TG must emphasize the necessity, based on interviews, of the need to do a detailed, cross-functional, cross-organizational, front-line to executive set of requirements, followed by adherence to standards, realistic costs-benefits, and time to value analysis, before one goes out to look for solutions. Similarly, the need to analyze processes in detail for their objectives, targets, costs, cycle times, vulnerabilities, value-add and non-value add components, before making process improvement, changes or re-engineering recommendations. While this sounds obvious, we believe these practices are not followed on a sustained and wide DoD enterprise basis.

Hence, based on our observations, interviews and research, the TG has included, in its Recommendations section at the end of this study, some guidelines for the DoD to consider in their data and analytics digital journey.

Task 10: Other relevant matters

"To provide any other related matters the Board determines relevant."

Through research, interviews, and observations, the TG has identified several overarching and important issues during the course of the study. These issues are of no surprise to any of the leadership in the DoD. However, while they have been included in the observations and recommendations, the TG feels, owing to their importance and urgency, they bear repeating:

The "Burning Platform." It has become apparent the "burning platform" on which the Department stands is not obvious to, or perhaps not understood well, by some of the leadership below the senior most levels at the DoD. Specifically, the TG is referring to the changing nature of warfare, the fact data is now a "critical weapons system," the China threat to U.S. global influence and the Chinese whole-of-society approach to data and analytics as a warfighting enabler, the looming budget pressures and demands for transparency and, finally, the value of data and analytics to the DoD and its key mission and goals. The TG believes this must be articulated and communicated with a sense of the greatest urgency from the top of the organization.

Collaboration within DoD. The mission and goals of DoD cannot be achieved in the new data and technology-driven environment without strong collaboration and an "enterprise-wide DoD" in terms of data, standards, definitions, and cross-enterprise analytics among the MilDeps and Services and the entire Fourth Estate. The data collaboration among all DoD organizations is no longer "nice to have" - it is now a national security imperative.

People. The DoD needs a better understanding of the workforce of today and how to quickly recruit and hire the right people, including thought leaders and technical expertise. This is both to augment internal resources and provide innovative direction to plan, design, and execute the data and analytics strategy to meet the needs of the "burning platform" and the China threat. This understanding must be translated into action involving the hiring process, position requirements, and career paths offered to the "data warriors." The federal government, in particular the DoD, has not changed its value proposition as an employer for decades. If DoD does not change, it will never catch up to private industry or the Nation's adversaries.

RECOMMENDATIONS

Based on the above and other findings, the DBB is making a number of recommendations. Many of these recommendations are included in this study as specific responses to the ToR tasks. However, it was felt, in order to present them as a single set of recommendations, the study should summarize them in a separate, concluding section. Many of the recommendations are obvious, but they have been emphasized again and again in interviews with private sector executives and thought leaders and so bear repeating.

Although currently behind leading private sector organizations, **DoD is moving in the right direction.** While DoD is much larger and varied than any existing private sector company, the current urgency of increasing threats, technology development, and expected additional resource constraints mean data must be treated as a strategic asset and data management and analytics need to be a top priority. It must be understood sophisticated data analytics and AI capabilities will not be possible until the DoD can generate timely, complete, comparable, and accurate data. In addition, the TG feels an unmodified opinion of the DoD financial statements will not be possible until this condition is met.

The DoD's CDO and data/analytics leaders know what needs to be done. However, execution is everything – it requires the operationalization of the Department's *Digital Modernization Strategy* and *Data Strategy*, empowerment of the CDO and CDO Council, appropriate and adequate budgeting and funding, and a strong change management and communication program to institutionalize the necessary organizational and cultural changes.

Specific Recommendations center around 4 areas:
- *"People and Organization"* - governance, the CDO, people, and culture.
- *"Data, Analytics, and Implementation."*
- *"Management of Technologies and Systems."*
- Given the TG's experience and discussions with some visionary thought leaders, the TG has suggested *A Future Initiative to Consider*. While there is a lot to be done in the short-medium term timeframe, the TG feels the DBB should be advising the DoD to start looking to "the stage beyond the next" where it can establish significant and lasting advantage over the competition.

Recommendation #1: People and Organization

The Chief Data Officer, Governance, People, and Culture

Chief Data Office, CDO Council, and Governance:
- Empower the CDO and the CDO Council to have complete authority, responsibility, and accountability for the *DoD Data Strategy* and its execution, the data, and the analytics. Have the CDO and CDO Council members operationalize the *DoD Data Strategy* across the DoD with the necessary resources, budgets, and authority to execute, with funding and budgets for the initiatives identified.
- Require the CDO Council to develop roles and responsibilities for CDOs across the entire enterprise and implement the data strategy and standardization for the DoD.
- Expand the CDO Council to include CDOs/data owners from across the DoD. The major components already have CDOs. Consider creating subgroups within the CDO Council focusing on the Fourth Estate, DAFA, and other key tenants of the data strategy.
- Ensure the ownership and accountability of data with the originating owner. Both civilian and military leadership need to be held responsible and accountable for implementing the overall data strategy. This, along with data accuracy and completeness, needs to be part of the ongoing performance management, promotion, reward, and related processes.
- Data (including standardization/master data management) must be treated as a corporate and "mission critical" asset, while analytics should ideally be structured in a "Federalist" system, with responsibility and authority residing in the organizations.
- Provide enterprise level funding to the CDO to implement the 2020 *DoD Data Strategy*. The CDO is identified as the responsible executive, but the budget to fund the strategy rests with the Services. To remedy this, the senior most Department leadership must ensure the PASs, MilDeps, and Fourth Estate are fully matrixed through their own CDOs to the Department level CDO. OSD should allocate budgets required to implement the modernization and data strategies across the entire enterprise. Put teeth into the CDO mandate and data management via the PPBE process and organization's and leader's performance measurement.

People
- Develop an "express lane" hiring process for "data warriors" (outside of the regular hiring process) with appropriate position requirements and career paths suitable for the skillsets and "different types" of people required. In this regard, DoD should use any and all special hiring authorities to accelerate the acquisition of needed "data warriors."
- Consider having a separate senior executive responsible for the hiring and retention of these "data warriors," perhaps reporting to the CDO. A recent Defense Innovation Board study suggested the establishment of just such an executive - a concept whose time may have arrived given the increasing role of data as a "weapons system."

Center of Excellence
- Establish a CoE for Data Analytics under the CDO. This CoE would be serve multiple purposes, including:
  - Serving as an organizational home and development center for analytical expertise;
  - Acting as an enabler and provide help to the different organizations within the DoD in terms of algorithm, analytics and technologies;

- Providing a training ground for people from the various organizations, having a very small core team with most of the members being rotated through from the DoD entities;
- Collecting and disseminating leading practices from the private industry and the rest of the DoD to all the organizations, (the CoE, for instance, might attempt to capture and propagate the lessons learned and best practices associated with the Army's Vantage system); and,
- Providing a central "design, sharing, and discussion" place for data and analytics professionals from across the DoD.

Recommendation #2: Data, Analytics, and Implementation

- Formalize the use of the current OSD analytics platform (ADVANA) and the "data lake" strategy to create a "single source of truth" for all DoD critical data to be used as the basis for management decisions and status. This should form part of the CDO Council's data strategy.
- Set in place Task Forces chaired by the CDOs/Data owners of the MilDeps and Services to fan out to the field in order to start developing data accuracy and completeness entry, maintenance, and ownership processes at the "front-line."
- Organize cross-organizational, cross-functional workshops - run by the various agencies and enabled by the CDO Council/CoE - to develop analytics, design metrics (real KPIs and metrics) and high-level requirements. This effort should involve field and executive users, thought leaders, data and domain experts. The U.S. Army's 'Vantage' platform is one such system which should be examined for use across the DoD
- Establish cross-functional teams - run by the various agencies and enabled by the CDO Council/CoE - (including data translators, visualization, functional experts and users) to design "ideal" dashboards and functionality- including cockpits for rapid information and trend assessment. This vital data for key decision making must include the few, critical KPIs, interaction and "drill down" capability, multiple modes of access and decision-making, analytics that are descriptive, predictive and prescriptive, and an avoidance of information overload.
- Use the Financial data from the DoD's Audit to conduct "enterprise-wide" DoD analysis to run the business – improve processes, reduce costs and fraud, enhance policies – in the areas of acquisition and contracts, sourcing and payables, logistics and inventory management, receivables, people management, and contractor management. All key data needs to be automated using tablets, where appropriate, and manual record keeping needs to be discontinued by a specific date.
- Design and implement a change management program, launched from the very top, under the direction of the CDO and transformation experts (and made public with the gravitas attached to the various Secretaries of the MilDeps and the DepSecDef), to include:
  - **Value propositions** linking data and analytics to the individual, MilDeps and Services, the Fourth Estate and DAFA, and the NDS goals and costs.
  - An **end state** (including a vision) that is credible and can be communicated to everyone.
  - A **communication program** emphasizing data and analytics as "key weapons systems," along with the processes, metrics and approaches.
  - Use of data, analytics and dashboards in **fact-driven decision making**
  - Data entry and accuracy processes.

Recommendation #3: Technologies and Systems

- Halt and re-set all data and analytics systems acquisition and development until detailed user-driven requirements, ROI and time to value estimates are made. Certain standards must be addressed at the central level to avoid "one-off" customized systems, lack of standards, buying just because of the "allure of technologies," unreasonable and unfocused ROIs, proliferation of diverse "standards," "information silos," and lack of integration.
- Systems to be reviewed and assessed include robotics process automation (RPA), extract, transform, and load (ETL), AI, ML, etc., - starting with the data and then moving upwards.
- Start on a process to rationalize and harmonize the mass of business information systems within the DoD, putting "teeth" into this with budgeting for new technologies and removing funding for old and redundant systems, and enforced end-of-life dates.
- Consider changing the funding pattern of data and analytics technologies to follow the life cycle pattern of design-development-testing-implementation-maintenance-replacement.

A Future Initiative to Consider

To quote from a leading and innovative thinker interviewed (and one with knowledge of technology in both the DoD and the private sector):

> *Everything companies are doing today can be described as linear improvement along the same flight path. What if there is a way to tackle the data accuracy, completeness and "intelligent" analytical issues to develop and implement standards, ensure data accuracy and completeness, and develop complex analytics and algorithms quickly and in a different way, using technology? For example, like the COBOL initiative in the DoD?*

This is a visionary initiative that could be funded on a research basis (somewhat like what is done in DARPA), **and is one which, with American ingenuity and innovation, will put the U.S. and the DoD far ahead of its adversaries.**
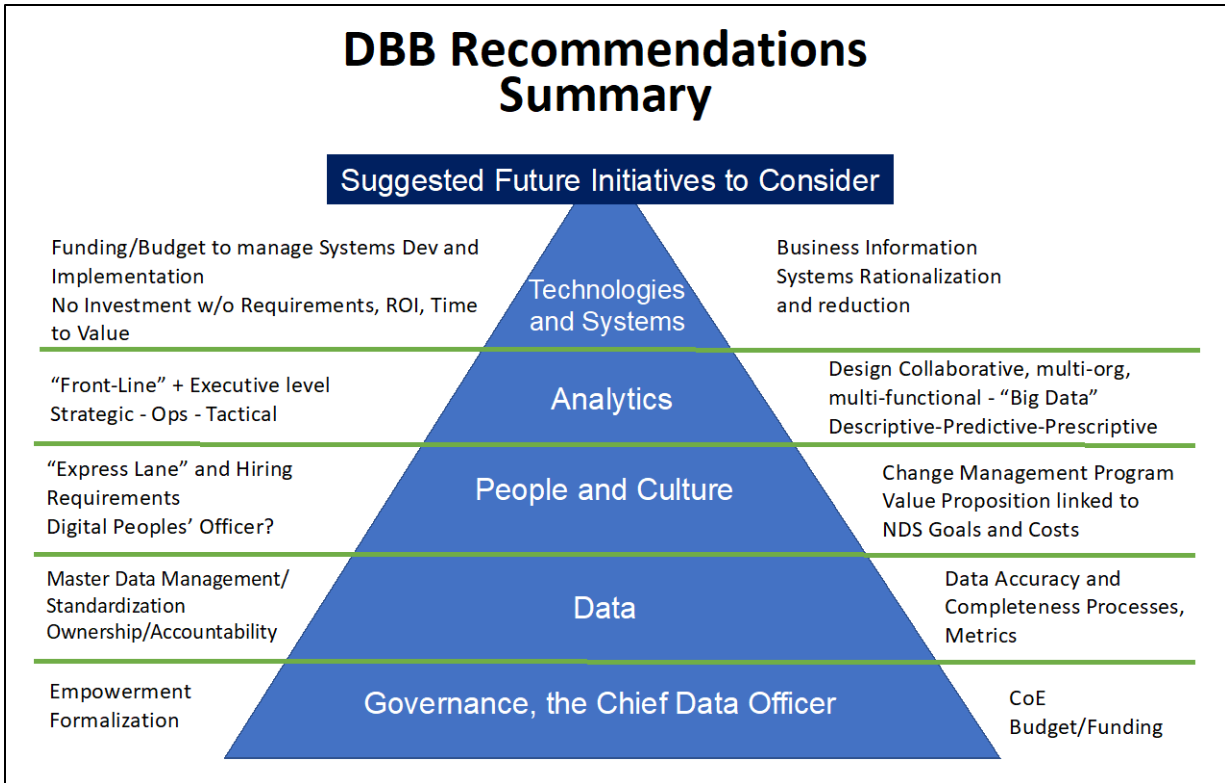
Figure 3: Summary of DBB Recommendations

A 1-page summary of the recommendations and the proposed sequence of priorities – starting with the base and basics and moving upwards – is shown in Figure 3. It must be understood many of these activities should be undertaken in phases, segments and in parallel for maximum speed and flexibility.

Respectfully submitted,

Christopher Gopal   **John O'Connor**   **David Walker**

APPENDICIES

TAB A: Terms of Reference - Audit/Performance Data Use in Private Industry
TAB B: Biographies of DBB Task Force Members
TAB C: DBB November 10, 2020 Public Meeting Presentation Slide Deck
TAB D: Interviews Conducted
TAB E: Questionnaire
TAB F: Literature Review
TAB G: Acronyms
TAB H: Public Comments

APPENDICES / BACK-UP SLIDES

Many DBB studies include appendices and/or extensive back-up slides which offer additional information in addition to the briefing provided to the DBB members at public meetings.

Appendices include information that is adjunct to the study itself.

Back-Up Slides are intended to provide DBB members additional information on complex topics and issues that the task group utilized to formulate the recommendations presented. The slides are not normally presented as part of the briefing given during the public meeting, unless required by the briefer to further clarify or elucidate a particular observation, finding, or recommendation. If Back-Up Slides were a part of the public briefing they will appear under one the following TABs; if not, no slides will be included.

Defense Business Board

TAB A

TERMS OF REFERENCE

AUG 0 3 2020

MEMORANDUM FOR THE DEFENSE BUSINESS BOARD

SUBJECT: Terms of Reference – Audit/Performance Data Use in Private Industry

Enterprise-wide business reform, highlighted as one of the National Defense Strategy's (NDS) three lines of effort, is a key Secretary of Defense priority for modernizing the Department and changing the way we do business. A foundational element of the broader NDS reform effort is the annual financial statement audit. In accordance with the Government Management Reform Act of 1994, the Department is committed to the audit because it is the most efficient way to evaluate an extraordinary large and complex organization. These audits are a proven commercial solution that use independent auditors to provide sample-based assessments of intricate operations. The DoD financial statement audit includes:

- Verifying count, location and condition of our military equipment, property, materials, and supplies;

- Testing security vulnerabilities in our business systems; and

- Validating the accuracy of records and actions, such as promotions and separations.

The Department's first-ever financial statement audit, completed in November 2018 and again in 2019, required us to develop transaction level data and is helping us improve the accuracy and timeliness of our data. Therefore, I direct the Defense Business Board ((DBB) or "the Board") to establish a task group to examine how financial statement and transaction level data is used by private industry to inform decision-making and identify best practices for adoption across the Department. Specifically the task group(s) will focus on the following:

- Review how DoD has used data in the past, describe any major challenges in using it for decision making, and identify any clear opportunities for improvement;

- As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD can change its business practices to be more efficient;

- As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD decision-makers can best take advantage of this data;

- Identify the leading private industry best practices of data management, analytics, dashboards, and decision processes;

- Examine how financial statement data and transaction level operational data is used in the private sector and how it could be applied to government (both for senior level decision making and for operational improvement);

- Share/explain analogous, world class private sector examples;

- Explain unique characteristics of the public sector that may limit or hinder application of private sector best practices and provide mitigation strategies, as appropriate;

- Provide specific recommendations and options for the presentation, periodicity, and organizational level of reporting financial statement and transaction level data to inform decisions;

- Provide specific recommendations and options for additional reform, to include tools and/or modifications to existing decision processes; and

- Any other related matters the Board determines relevant.

Unless deemed classified or otherwise not releasable, the task group findings, observations, and recommendations will be presented to the full Board for thorough open discussion and deliberation in a noticed public meeting. The Board will provide its final recommendations to me no later than November 13, 2020. I authorize the Board to establish a subcommittee to perform this study if deemed necessary by the Board's chair.

In conducting its work, the Board has my full support to meet with Department leaders and all requests for data or information shall be honored that may be relevant to its fact-finding and research under this terms of reference. Components should respond to requests for data/information from the Board within five business days. Once material is provided to the Board, it becomes a permanent part of the Board's record.

As such, I direct the Office of the Secretary of Defense Principal Staff Assistants and Component Heads to cooperate and promptly facilitate requests by Board staff regarding access to relevant personnel and information deemed necessary, as directed by paragraphs 5.1.8. and 5.3.4. of DoD Instruction 5105.04, "Department of Defense Federal Advisory Committee Management Program," and in conformance with applicable security classifications.

All data/information provided is subject to public inspection unless the originating Component office properly marks the data/information with the appropriate classification and Freedom of Information Act exemption categories before the data/information is released to the Board. The Board has physical storage capability, and electronic storage and communications capability on both the non-classified and the classified networks to support receipt of material at the Secret level. Each Component should remember that DBB members, as special government employee members of a DoD Federal advisory committee, will not be given any access to the DoD Network, to include DoD email systems.

The Board will operate in conformity with and pursuant to the Federal Advisory Committee Act, the Government in the Sunshine Act, and other applicable federal statutes and regulations. Individual Board members do not have the authority to make decisions or recommendations on behalf of the Board, nor report directly to any federal representative. Members of the Board are subject to title 18, U.S.C., section 208, governing conflicts of interest.

Thank you in advance for your cooperation with this important undertaking that will inform decisions on how the Department addresses national security challenges in the coming decades. My points of contact for this effort are Jennifer Hill, Executive Director of the DBB, and Colonel Chuck Brewer, DBB Military Assistant.

Defense Business Board

TAB B

BIOGRAPHIES OF DBB TASK FORCE MEMBERS

Christopher S. Gopal, Ph.D.
Strategic Solutions Advisor, OCX Cognition

Dr. Gopal has over 35 years of experience in global supply chain and operations strategy, execution, and technology in a career that has encompassed industry executive management and consulting. His experience has focused on innovating, structuring, improving, and managing supply chain operations, business processes, services, and technology use for leading global companies.

For products companies, this has included developing innovative supply chain, customer life cycle experience and information strategies on a global basis, cost reduction, risk mitigation, stabilizing and improving operational efficiency, and executing for world-class results.

In the services arena, Dr. Gopal has built and run world-class professional services and consulting practices for major companies, consulted in supply chain strategy, management and technology with leading global companies, and has developed technology solutions, innovative new services in accelerated strategy and process design, and executive education programs for both large global and small companies.

Dr. Gopal has held executive positions at several leading companies, including VP, World Wide Operations and Services at Overland Storage, VP in World-Wide Operations at Dell Computer, Partner & Director of Global Supply Chain & Operations services at Ernst & Young Consulting, as well as executive VP positions at Unisys and SAIC. His consulting clients have included prominent global companies across a range of industries, and he has served as an executive and consultant for several major companies and consultancies.

Dr. Gopal is a recognized thought leader in the field of global supply chain & operations. He is the co-author of three books, the latest being "Supercharging Supply Chains: Creating Shareholder Value through Operations Excellence" John Wiley & Sons; (Now published in Japanese), has authored several articles and is an invited speaker at numerous international business conferences for Business Week, Defense Logistics Agency, the Harvard Business Review, the Milken Institute Global Forum and the Council for Supply Chain Management Professionals, among others. He has been nominated to the SC Digest 2020 "Supply Chain Gurus" panel, and was also a member of the 2015-2019 panels.

He has served as an advisor and board member to leading–edge technology companies, including a leading corporate social responsibility platform company, and has assisted in several startups. Dr. Gopal served as an advisor to a prominent think tank project in Washington on Industrial Competitiveness, and recently served on a White House sub-committee on Manufacturing Technologies.

Dr. Gopal currently is a strategic advisor to OCX Cognition, a company that consults and develops software to integrate and organize the Integrated Supply Chain and Customer Life

Cycle Experience. Chris consults with companies in supply chain & operations, risk mitigation, e-business, technology and solutions development. He teaches at the University of California San Diego and the University of Southern California. Chris serves on the Advisory Board of the Global Supply Chain Management Center at the University of Southern California.

Mr. Gopal holds a Ph.D. in Business from the University of Southern California, an MBA from the Cranfield School of Management, UK, and a B.Sc. in Physics, Science and Mathematics from Bangalore University, India.
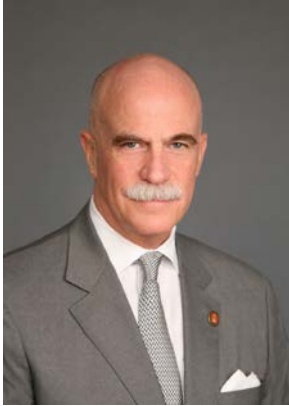
John M. B. O'Connor
Chairman, J.H. Whitney Investment Management, LLC

Mr. John O'Connor is Chairman and Chief Executive Officer of J.H. Whitney Investment Management, LLC (an alternative investment firm), a position he has held since January 2005, and Chief Executive Officer of Whitney Strategic Services, LLC (a provider of global economic advisory services to the US Department of Defense).

From January 2009 through March 2011, he served as Chief Executive Officer of Tactronics Holdings, LLC (a Whitney Capital Partners portfolio holding company that provided tactical integrated electronic systems to U.S. and foreign military customers as well as the composite armor solutions for military vehicles through its Armostruxx division).

Previously, Mr. O'Connor was Chairman of JP Morgan Alternative Asset Management, Inc. (part of the investment manager arm of JP Morgan) and an Executive Partner of JP Morgan Partners (a private equity firm). He was also a member of the Risk Management Committee of JP Morgan Chase, which was responsible for policy formulation and oversight of all market and credit risk taking activities globally.

Mr. O'Connor earned a bachelor's degree in economics from Tulane University and a master's degree in business administration from Columbia University Graduate School of Business.

Mr. O'Connor is a member of the Board of Directors at Boon Logic, Inc. (a privately held developer of real-time unsupervised machine learning solutions), Sequoia Holdings Inc. (a provider of engineering and cloud orchestration services to the national security sector). He also serves on the advisory boards of American Friends of the Clock Tower Fund, Avenue Impact Strategies, Chart National Capital, Global Guardian, LLC, Grayson-Jockey Club Research Foundation and New York Green Bank.

Mr. O'Connor is also Chairman of the American Friends of the Clock Tower Fund and Treasurer of the UK Game Conservancy and Wildlife Trust. Olin director since January 2006; he is a member of the Audit Committee and the Directors and Corporate Governance Committee.

Mr. O'Connor serves as a member of the Department of Defense Business Board.

Mr. O'Connor's hedge fund, investment banking and National Security experience allow him to contribute broad financial and global expertise

The Honorable David M. Walker
Distinguished Visiting Professor (William J. Crowe Chair)
U.S. Naval Academy

Mr. Walker is a nationally and internationally recognized fiscal responsibility, government transformation/accountability, human capital, and retirement security expert. He has over 40 years of executive level experience in the public, private and non-profit sectors, including heading three federal agencies, two non-profits, and serving as Comptroller General of the United States and CEO of the U.S. Government Accountability Office (GAO) for almost 10 years. Mr. Walker is also a writer, speaker and media commentator. He has authored three books, the latest was entitled *Comeback America: Turning the Country Around and Restoring Fiscal Responsibility (2010)*, which achieved National Bestseller status, and he plans to publish a fourth book in 2021. He has appeared in several major programs and documentaries, including being the primary subject in a 60 Minutes segment and the critically acclaimed documentary I.O.U.S.A.

Mr. Walker is currently the Distinguished Visiting Professor (William J. Crowe Chair) at the U.S. Naval Academy where he teaches the Economics of National Security. Previously, he served as a Senior Strategic Advisor for PwC's Public Sector Practice (now Guidehouse). Mr. Walker was the Founder, President and CEO of the Comeback America Initiative (CAI). In this capacity he led CAI's efforts to promote fiscal responsibility and sustainability by engaging the public and assisting key policymakers on a non-partisan basis to help achieve solutions to America's federal, state and local fiscal imbalances. During this period, he conducted a nationally recognized Fiscal Responsibility Solutions Tour that covered 10,000 miles and included 27 states plus D.C.

Prior to founding CAI, Mr. Walker served as the first President and CEO of the Peter G. Peterson Foundation that promotes fiscal responsibility. Previously, he served as the seventh Comptroller General of the United States and head of the U.S. Government Accountability Office (GAO) for almost ten years (1998-2008). GAO conducts financial, performance and compliance audits, a range of policy and operational research and analyses, promulgates Generally Accepted Governmental Auditing Standards, and renders decisions on bid protests on federal contracts. Under Mr. Walker's leadership, GAO underwent a dramatic and highly successful transformation which, among other things, resulted rightsizing the agency, significantly increasing it visibility, credibility and productivity, and achieving over $380 billion in financial benefits and many other non-financial benefits over a 10-year period.

Mr. Walker's appointment as Comptroller General was one of his three presidential appointments each by different Presidents (i.e., Reagan, Bush 41, and Clinton) during his 16 years of total federal service. He was confirmed unanimously by the U.S. Senate for all three of his Presidential appointments. His previous Presidential appointments were Assistant Secretary of Labor for the current Employee Benefit Security Administration, and as one of two Public Trustees for Social Security and Medicare. Mr. Walker also served as Acting Executive Director, Deputy Executive Director and Chief Negotiator for the Pension Benefit Guaranty

Corporation. He also has over 20 years of private sector experience, including approximately 10 years as a Partner and Global Managing Director of the Human Capital Services Practice for Arthur Andersen LLP. His initial private sector experience was with Price Waterhouse & Co., Coopers & Lybrand and Source Services Corporation.

Mr. Walker currently serves on various boards and advisory groups, including as Chairman of the Government Transformation Initiative Board, as a member of Advisory Committees for Institute for Truth in Accounting, the Center for the Study of the Presidency the Congress, the Center for State-led National Debt Solutions, and the Peter G. Peterson Foundation. He previously served as Chairman of the Independent Audit Advisory Committee (IAAC) for the United Nations, Chairman of the U.S. Intergovernmental Audit Forum, and as a member of the Board of Directors for the International Organization of Supreme Audit Institutions, AARP, the Committee for a Responsible Federal Budget, the Partnership for Public Service, and the Connecticut Municipal Accountability Review Board. He is also a past member of the Trilateral Commission.

Mr. Walker is an inductee in the Accounting Hall of Fame, the Internal Audit Hall of Fame, the National Academy of Public Administration, and the National Academy of Social Insurance. In addition, he is a member of and has held various leadership positions in Rotary International and the Sons of the American Revolution (SAR).

Mr. Walker is a non-practicing CPA who has a B.S. in Accounting from Jacksonville University, an SMG Certificate from the JFK School of Government at Harvard University, a Capstone Certificate from the National War College, and four honorary doctorate degrees from American University, Bryant University, Jacksonville University and Lincoln Memorial University. He has won numerous national and international leadership, professional, and public service awards, including top awards from two heads of state (i.e., Austria and Indonesia) and two U.S. Cabinet Secretaries (i.e., Defense and Labor), the top award for his CPA profession (i.e., AICPA Gold Medal), and the first and only Alexander Hamilton Award for economic and fiscal policy leadership from the Center for the Study of the Presidency and the Congress.

Distinguished Visiting Professor (Crowe Chair) - USNA
Former U.S. Comptroller General

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Defense Business Board

TAB C

PUBLIC MEETING PRESENTATION

NOVEMBER 10, 2020

PROVIDED TO THE DEFENSE BUSINESS BOARD

DEFENSE BUSINESS BOARD

Audit/Performance Data Use & Analytics in the Private Industry, and applicability to the DoD

November 10, 2020

21-S-0304

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- Using Financial data for Internal Improvement

DBB Recommendations

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Assignment

The Deputy Secretary of Defense directed the DBB to examine the following areas:

- Assess the use of audit and performance data in the DoD

- Examine how audit and performance-related data and analytics are used by leading companies in private industry to gain insights and drive successful outcomes

- Provide recommendations to assist Department executives in optimizing decision-making to ensure their business outcomes are efficient and effective, now and in the future

The Specific Terms are outlined in the Appendix, while specific responses to the TOR's tasks are laid out in the accompanying document

For the purposes of this overall presentation, however, we decided to combine these into the logical and actionable segments described above

Context

1. Although the DoD's annual audit plays an important role, this study is not about the audit process. It's about the **_data_** collected from the audit and its potential use through analytics

2. DoD recognizes the fact that as a result of the audit, it has begun to collect vast amounts of financial transaction data, which if properly analyzed, could reveal significant opportunities for internal improvements

3. DoD's existing practices of data management and analytics has started comparatively recently, taken on increased urgency, and is behind the private sector for many reasons

4. DoD needs validation and insights from leading practices in analogous private sector companies in order to design, manage and implement a powerful data management and analytics capability

5. DoD leadership needs specific recommendations, given current DoD initiatives and based on private sector leading practices, in order to achieve NDS and Cost goals

The Task Group & Methodology

DBB Task Group Members
Dr. Chris Gopal (TG Chair)
Mr. John O'Connor
Hon David Walker

Staff Support
Col Chuck Brewer, USMC
Mr. Web Bridges, DBB Staff
Mrs. Leah Glaccum, DBB Staff

Process & Methodology

- The quick turnaround and wide scope required a focused approach at an executive level
- Conducted 50 **interviews** (senior executives & thought leaders) in the DoD, private industry, think tanks, & academia, using a structured set of interview questionnaires
- **Researched** the current state of private industry leading practices using wide variety of secondary research sources & white papers
- **Described 4 case studies** on audit/big data management and analytics leading practices.
- **Examined a number of strategies,** studies & reports from the DoD and GAO
- Studied germane statutory requirements

All interviews were conducted under Chatham House rules so that interviewees could feel free to provide honest and frank feedback without fear of retribution or consequence. In addition, 2 of the companies featured in the caselets asked that their names not be mentioned

"The Bottom Line"

- While DoD is much larger and varied than private sector companies, the current urgency of increasing threats, technology development and expected additional resource constraints mean that data must be treated as a "strategic asset" and data management and analytics needs to be a top priority

- DoD has launched initiatives consistent with the leading practices in private industry, is making progress on its data challenges but lags leading private sector practices by a wide margin. Leaders know what strategies are required.. the key is execution

- The CDO and Data Council must be empowered, formalized and made accountable for the data strategy, its operationalization and data quality. Data ownership must lie with the data originators and both analytics and data processes must start at the "front-line"

- Both civilian and military leadership need to be held responsible and accountable for implementing the overall data strategy. It needs to be part of the ongoing performance management and related processes

- The data strategy at the CDO and agency levels must be funded and budgeted

- A Change Management Program must be initiated from the very top to demonstrate the value proposition and linkage of data, collaboration and analytics to achieving NDS and cost goals, as well as unit and individual objectives

"The Bottom Line"

- All key data needs to be automated using tablets, where appropriate, and manual record keeping needs to be discontinued by a specific date

- Sophisticated data analytics and AI capabilities will not be possible until the DoD can generate timely, complete, comparable and accurate data. In addition, an unmodified opinion of the DoD financial statements will not be possible until this criteria is met

- Dashboards should be based on the most vital data for key decision making, and should be a collaborative effort with the users

- DoD needs to upgrade its data management and analytical personnel using expedited hiring, appropriate requirements and enhanced training

- Enterprise Data lakes/pools (e.g., ADVANA) should be mandated for use in key decision making

- Existing financial/ERP systems need to be significantly rationalized and reduced with End-of-Life Dates established and funding adjusted

The Imperative

The urgency to treat data as a "strategic asset," to improve and innovate DoD data management and analytics is driven by three main factors:

- *The China threat* and, in particular, their adoption of the "whole of society" approach to national datasets, including all foreign people and firms. This is collected and utilized under their "Civil-Military Fusion" doctrine and supporting Cyber Security laws. This approach was articulated by Xi Jinping saying that China needs to "promote the deepened integration of internet, big data, and artificial intelligence with the real economy." The threat includes the Chinese control of the supply and manufacturing of many critical supply chains and the data that drives them. DoD must understand that they are in a unique position as the only department which can lead a drive for whole of Government data aggregation and utilization

- *The accelerated and exponential development and implementation* of new data, "intelligence," and analytics technologies

- A lack of urgency in adoption and use could place DoD behind its peer competition

- *Cost pressures* on budgets and defense spending that drive the need for data and analytics to drive efficiencies

https://www.ft.com/content/e33a6994-447e-11e8-93cf-67ac3a6482fd
https://www.forbes.com/sites/cognitiveworld/2020/01/14/china-artificial-intelligence-superpower/?sh=e15f65b2f053
https://www.cnas.org/publications/reports/rising-to-the-china-challenge
https://www.rand.org/pubs/research_reports/RRA176-1.html

DoD: Current State

- DoD has begun a journey to manage its data more strategically, with several initiatives that are consistent with generally-accepted leading practices in the private sector

- DoD's senior leaders responsible for data management and analytics know what must be done, however, there are some obstacles and challenges

DoD: Current State
The Journey has begun

DoD is undertaking, and has launched, several initiatives that are consistent with generally accepted leading practices in the private sector

- The necessary skillsets are in place at the top, and the data and analytics leaders recognize most of the issues and challenges raised in this report
- The 2019 Digital Modernization Strategy and the 2020 Data Strategy both establish a good framework
- The initial establishment of a CDO Council responsible for data governance.
- The implementation of a data lake strategy (e.g., ADVANA), where data is populated based on executive information needs
- The force function from the top of using real-time data from the approved data lake (ADVANA) as the basis for status and management decisions
- Analytics and dashboard development based on the top leadership needs (which is necessary but not sufficient)
- A nascent data sharing culture is developing in the DoD (but not all data & it is not pervasive) across agencies
- The proposal of a senior executive to oversee the hiring and retention of scarce "data warrior" talents (a new innovative concept)

https://www.fedscoop.com/usda-assistant-chief-data-officers/

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DoD: Current State
But….Some Challenges

The DoD faces several challenges and some key management imperatives in achieving a goal of a "data-driven" warfighting machine - lack of urgency and the Empowerment and Funding of the CDO and the CDO Council

The Urgency:
- The pace of implementation and change is slow and relies on voluntary collaboration
- Our interviews have reveled that there is a lack of urgency in developing and executing data management and analytics to a world-class status

The CDO and the CDO Council - Empowerment, Funding and Organization:
- The CDO Council does not formally include all the CDOs and data owners from the different agencies and organizations, however, the CDO communicates with all executives and maintains excellent relations with them
- The CDO and the CDO Council does not have the appropriate authorities to implement collaborative strategies. This is compounded by title 10
- There is insufficient budget committed to realistically design, drive & implement the data strategies, technologies and initiatives - in data, analytics, legacy systems & business systems rationalization. Strategic planning for data is not consistent with budget allocations to support it
- Additionally, the funding of software and systems follows the same pattern as other DoD funding, even though the dynamics and time frames of design-development-implementation are very different

DoD: Current State
But….Some Challenges

The DoD challenges include a lack of vision and appreciation of data and analytics in achieving NDS and cost goals, a slow hiring process and lack of necessary skillsets

Culture:
- The different organizations (at all levels) do not have a consistent vision of the end state, or the value that across-the-board data sharing (instead of "hoarding"), collaboration, data management and analytics provide directly to the NDS and cost goals
- Senior level leaders in the Services and DAFAs have a strong appreciation for the use of financial data to identify operational efficiencies and improvements, however, there are inconsistencies on the degree to which this appreciation cascades down their organizations. The focus on analytics and dashboards seems to be mainly at the senior management level, with little on the front-line operator level
- The focus of DoD leadership appears to be on the excitement of advanced technologies, not on the basics of data accuracy and completeness

People/Skills
- There is a lack of internal resources that we can define as "data warriors" to implement the data modernization and data strategy (e.g. translators, scientists, domain expertise and process design)
- The hiring process is too long for DoD to be competitive in the recruitment and retention of data warriors. DoD has no value proposition to attract and engage them

Some additional challenges include far too many redundant and outdated systems and a lack of complete and standardized data

Complexity, Redundancy:
- There are **far too many** business information systems through the DoD, many redundant or using outdated technologies, and many protected by their "host" organizations (our interviews surfaced over 326 different and separate financial management systems, over 10,000 different and disconnected data management systems, and 4,700 data warehouses)

- The plan to decrease those systems (Investment Management Guide for Defense Business Systems) is not aggressive nor does it hold DoD entities accountable for reducing the number of those systems

Data:
- Data is not always accurate, complete or standardized throughout the DoD, and this makes it difficult to effectively use the data. The use of data can be characterized as fragmented and siloed, but progress is being made as DoD entities move through the data maturity process

Private Sector:
Leading Practices: Data

A strong, centralized data strategy, including standardization, completeness, ownership, developed and owned by an Empowered CDO and Data Council

- Development of a strong, centralized data strategy that includes governance, ownership and accountability, metrics, accuracy and completeness, standardization and Master Data Management, and technologies

- The Data Strategy is developed by the CDO or the Data Council, depending on the scope and complexity of the organization

- The entire data and analytics journey begins with data - accuracy, completion processes, "cleansing" and standardization across the organization

- Some leading companies adopt a data maturity model to guide themselves and set milestones on their data journey. Some of these models are standard commercially available models (e.g., from CMMI or DCAM), while others are tailored to the specific company's situation

  (For example: One of the world's largest professional services firm uses a tailored [from an "off the shelf" available model] data maturity model to guide and measure its own progress)

Data completeness and accuracy processes, along with analytics to run the business must start at the operational "front-line' level

- Digitalization and analytics starts in "front-line" where operations are conducted and data is generated. This is the basis on which the business runs and is executed. It then moves to the executive leadership where the business is run, course changes are made, and strategies are developed

  (For example: A major global multi-BU corporation began the effort to start collecting, digitizing and cleaning data at the lowest level.- the "front line." Project teams visited the front line workers on manufacturing plants, warehouses, testing facilities, loading docks, etc.)

A Data Culture which includes understanding of the criticality, involvement, and the right skillsets are critical in the organization

- A Data Culture: where people at all levels recognize the importance of data and analytics to achieving their individual goals, BU goals and the competitive goals of the company

- People at all levels and Business Units are involved in the development of analytics that they use and are needed for the effective functions of their job

- All the companies are faced with the issues of a lack of talent and devote time and effort to addressing this

- Key people that private companies are looking to hire include data translators, scientists, domain experts and process engineering

(For example: In a global multi-BU organization, the CDO recognized that the organization did not have the right skill-sets to either design or execute a digital transformation. As a result, 76% of the core project team was populated from people brought in from the outside of the company. 80% of these people had thought leadership, functional and domain expertise, with hands-on responsibilities and the remainder were analytical experts with less technical background. Internal hires to the core project team were high-performers with a strong familiarity for how the enterprise worked. As the initiative progressed, the data and analytics expertise was distributed between the BUs and the Corporate team (which essentially worked as a Center of Excellence). One of the responsibilities of the Corporate "CoE" was to provide training and support to the BUs)

Hiring processes and requirements must be developed "out of the box" and decisions based on fast a part of the culture

- Fast hiring processes and value propositions are necessary to compete against other companies; Some leading companies use a fast track process for this

   (For example: a major global consumer products company, realizing that they would have to contend with years of embedded practices and attitudes to hiring, implemented an "Express Lane" hiring process for both the Corporate CoE and BUs)

- Unintentionally utilizing low quality data to perform data analytics can harm the organization and affect overall trust in the data

- People make decisions based on data - "fact-based decisions," and measure decisions and progress based on facts and hard data

   (For example: in one of the largest professional services/audit forms in the world, the CEO met with all the global senior leadership in one set of sessions, jointly set key goals in terms of their competitive imperatives. While the cultures were different, the objectives were the same. They then took these all the way to the BU and individual performance measurement across the globe. The metrics were built it into the regional/BU leader's' performance metrics and driven lower down in the organization to the junior levels. This removed much of the pointless reporting and focused on what mattered. It was only after this step, where acceptable decisions were made on accurate data, they they started evaluating their analytics – what problems were they wanting to solve, and what it was they wanted to analyze)

An empowered CDO, CDO Council, with the necessary authority, budget and centralization/decentralization ownership is critical to success

- Leading companies appoint a CDO to develop and own the data strategy, standards and analytics, usually in a Federalist model

- The CDO, if in a conglomerate or multi-national organization, runs a CDO Council composed of executives (sometimes other CDOs) from across the organization, or functional heads, who are tasked with owning the data and analytics in their organizations

- The CDO office, CoE, Data Strategy and implementation, and technologies are all budgeted with resources and people - both centrally and funded through the different BUs and functions

- A combination of centralization/decentralization is used, where data standards and strategies are centralized, corporate-level analytics development is centralized, and BU/functional-level analytics are decentralized

Centers of Excellence are vital enablers

- Centers of Excellence (CoE) - usually under the CDO - are set up to provide several functions - a place for scarce talent, a place to train internal people through a rotation method, a place to collect and disseminate leading practices, a place to conduct collaborative design, development and implementation sessions with people from across the units, and a non-threatening place to raise the entire level of the organization

    (For example: The world's largest company established a CoE called its 'Data Café.' This CoE is a state-of-the-art analytics hub located within its headquarters. This hub works to reinforce the data driven culture by not only providing centralized analysis but pushing out governance models for standard analytics)

A Vision and Analytics Design are Critical Elements

- Many leading companies are adopting the practices and strategies for Industry 4.0 - an overarching set of strategies and a vison for the digitalization future. We believe that our major competitor has adopted this:

  "Enable autonomous decision-making processes, monitor assets and processes in real-time, and enable equally real-time connected value creation networks through early involvement of stakeholders, and vertical and horizontal integration"

- Leading companies view and address (design, implement) dashboards and analytics by **Category** - Strategic, Operational and Tactical, depending on the nature of the information, decisions and organizational level, and **Type** - Descriptive, Predictive and Prescriptive (Intelligent algorithms) - they start with Descriptive, then move up to Predictive and Prescriptive

- KPIs - are kept to the critical few (and these are determined carefully)

- Equally important, they view the real value of advanced analytics as coming from the "intelligent" analysis of multi-BU, multi-functional "Big Data"

  (For example: A major entertainment company, whose success , or failure, depends on the pinpoint assessment of consumer needs, has developed a system to analyze such data. They are among the most successful companies of their class, and they have shown that "intelligent" analytics outperforms executive non fact-based decision making consistently)

Advanced Dashboard Design geared to rapid and accurate decision-making is necessary

- Dashboards are designed by the people using them in collaboration with analytics, visualization and data experts, and the design of dashboards, regardless of level, is done to maximize decision-making potential (visually and type of information presented) and to prevent information overload. Dashboard/Visualization is designed to be interactive, remote and usable from a variety of media, determined, naturally, by cyber-security and reaction-time standards

- Several companies have developed interactive "cockpits" for their executives to keep track of operations, trends and to help run the business

   (For example: One of the biggest global CPG companies, for example, developed software that allows their executives at any level in the company to customize dashboards for themselves. This customizable dashboard app is called their 'cockpit' and users can put it on their smartphones, tablets or laptops. The users are given the ability to customize which performance metrics, lines of business, etc. that interests them)

Reporting must be at a granular level, while the assessment and acquisition of technologies must be done in a measured fashion. Rationalization and reduction of existing business systems is a necessary component

- Reporting is done at the lowest granularity possible - it is felt that this can always be raised to higher levels of aggregation if needed - and at as near real-time as necessary depending on the information needed

  (For example: A major global conglomerate started the process by designing analytics to help front line workers measure success and goal progress. The project mantra was to focus first on the trenches and then work their way up the organization as they built a strong and reliable foundation of clean data)

- Technologies are never invested in for production until rigorous requirements are defined in collaboration with users, ROI (including strategic, non-quantifiable factors) and time to value/implementation are estimated. Most of these technologies/concepts are first evaluated with "Proofs of Concept" to determine their viability, economics and scalability

- Leading companies rationalize and harmonize their existing business information systems to eliminate redundancy, costs, confusion and take them down to a few

  (For example: A major global diversified company took over 6 years to reduce its number of ERP systems from over 600 down to 32. They too adopted a "data lake" strategy to gather raw data into a single source of truth)

Private Sector
Leading practices: Using Financial Data for internal improvement

As a result of the Audit, DoD has a considerable body of financial transaction data. Leading private sector companies use this data to analyze and drive significant operational benefits. Some of the major areas include:

- **Receivables:** Receivables analysis can increase payment velocity, decrease probability of default, & recoup owed money

- **Payables:** An analysis of payables and spend analysis can reveal the spectrum of terms, adherence to terms, spend by vendor, source and category -to drive improved terms, multiple sourcing and risk management, and, in some cases, surface potential collusion or supplier favoritism by procurement managers

- **Inventory:** Analysis of inventory data predict spending, reduce over-ordering, avoid shortages, examine consumption and service levels, reduce excess and obsolete inventory, re-distribute and rebalance inventory by location as needed, optimize working capital and, in general, highlight poor inventory management for action

- **Logistics:** Analysis of logistics (transportation and warehousing) can reveal directional trends in use of modes as well as their related costs, expediting and effectiveness of planning. Additionally, analysis of warehouse volumes and costs can highlight inefficiencies, usage and storage requirements

- **Vendors & Acquisitions:** Analyzing procurement financial data can uncover insights for negotiations, vendor segmentation, vendor performance management, annual purchasing strategy, drive improved sourcing, better pricing & terms

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One leading expert, familiar with both the history of technology in the DoD and the private sector, described and painted a vision of the future of data and analytics:

"Everything companies are doing today can be described as linear improvement along the same flight path.

What if there is a way to tackle the data accuracy, completeness and "intelligent" analytical issues to develop and implement standards, ensure data accuracy and completeness, and develop complex analytics and algorithms quickly?

For example, like the COBOL initiative in the DoD?"

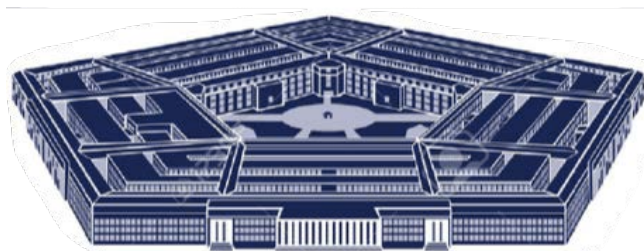This got us thinking - can today's DoD envision and do something similar?

We identified, interviewed and researched leading companies to provide case studies with strong relevance to current DoD challenges

Case Study 1

- Global professional services firm, 300k employees & $37B annual rev
- Multiple autonomous business units around the globe with different metrics to measure performance & service output
- Poor data collection, quality & infrastructure were all issues preventing internal improvements & marketplace dominance
- Lack of modern data infrastructure limited analytical capabilities that were critical to improving organizational health

Case Study 2 — Walmart

- World's largest retail company, 2.2 million employees & $500B in rev
- Data infrastructure not sufficient to collect, organize & analyze massive quantities of daily transactional data
- Lack of analytical & data management skillsets were limiting growth of company analytics
- Market competition & need to recapture expenses drove need to use real-time data collection to drive decision making and resource allocation

Case Study 3 — P&G

- World's largest consumer pkgd goods co. with $65B in annual revenue
- Operational focus on procurement, manufacturing & logistics
- Increasing market competition created the need for internal analytics to drive internal efficiencies
- Multiple manufacturing facilities with analog data collection needed to digitize and drive real-time data
- Enterprise needed dashboards to aid decision making at every level, especially the front line

Case Study 4

- Multinational industrial conglomerate, 200k employees & $100B in annual revenue
- Enterprise grew through mergers & acquisitions
- High tech manufacturing operations with multiple autonomous BU's around globe with legacy IT systems
- Data sharing, data quality & accountability were issues across the enterprise
- Ineffective data governance model
- Buy-in & increased support needed by senior executive team

Center box:

- Multiple autonomous entities
- 2 million employees
- Data infrastructure & quality issues
- Data access issues
- 100's of legacy systems
- Unenforced data governance model
- No incentive/disincentive for compliance with OSD directives
- Nascent data analytics capability
- Org lacks analytics talent & skillsets
- Need for predictive analytics to aid decision making
- Needs appropriate dashboards at each level
- Peer competition creating pressure to drive internal improvement quickly

These lessons are built into the Leading Practices

DoD is moving in the right direction

- The DoD CDO and Data/Analytics leaders know what needs to be done.
- However, the key lies in operationalization of the The Digital Modernization and Data Strategies, empowerment of the function to implement, adequate budgeting and funding, and a strong change management and communication program to institutionalize the necessary changes

  Our Recommendations center around 4 areas:

  - Governance, the Chief Data Officer, People and Culture
  - Data, Analytics, & Implementation
  - Technologies and Systems
  - Suggested Future Initiatives to Consider

DBB Recommendations

Governance, the Chief Data Officer, People and Culture:

- Require the CDO Council to develop roles and responsibilities for CDOs across the entire enterprise and implement the data strategy and standardization for the DoD. This CDO Council should be held accountable for the data
- Expand the CDO Council to include CDOs/data owners from across the DoD. They already have all the CDOs. Consider creating subgroups within the CDO council that focus on DAFAs and or other key tenants of the data strategy
- Have the CDO and CDO council members operationalize the DoD Data Strategy with the necessary resources, budgets and authority to execute
- Ensure the ownership and accountability of data with the originating owner
- Provide enterprise level funding to the CDO to implement the 2020 Data Strategy. The CDO is identified as the responsible executive, but the budget to fund the strategy rests with the Services. To remedy this incongruence, senior Department leadership must ensure that the Military Services and DAFAs, matrixed through their own CDOs to the Department level CDO, allocate the budget required to implement the modernization and data strategies across the Department
- Develop a "express lane" hiring process for "data warriors" (outside of the regular hiring process) with appropriate requirements suitable for the skillsets and people involved
- Consider having a separate executive responsible for the hiring and retention of these "data warriors", perhaps reporting into the CDO or Central HR. A recent DIB study suggested the establishment of a "Digital Peoples' Officer" - a concept whose time may have arrived given the increasing role of data as a "weapons system"
- Establish a Center of Excellence for Data Analytics under the CDO
- Put teeth into the CDO mandate and data management via PPBE process and performance measurement

DBB Recommendations

Data, Analytics, & Implementation:

- Design and Implement a Change Management Program under the direction of the CDO and transformation experts, to include:
  - Value Propositions linking data and analytics to the individual, Agency, NSD goals and costs
  - The End State that can be communicated
  - Communication program emphasizing data and analytics as "key weapons systems", along with the processes, metrics and approaches
  - Use of data and analytics in fact-driven decision making
  - Use of dashboards
  - Data entry and accuracy processes
  - And make it public with the gravitas attached to the various secretaries and the DSD
- Formalize the use of the selected analytics platform (e.g. ADVANA) and the "data lake" strategy to provide the "single source of truth" for the DoD Critical Data, and to be used as the basis for management decisions and status
- Set in place Task Forces run by the CDOs/Data owners of different services to fan out to the field, start developing data accuracy and completeness entry, maintenance and ownership processes
- Cross-functional teams (including data translators, visualization, functional and users) to design "ideal" dashboards and functionality- including cockpits for rapid information and trend assessment
- Cross-organizational, cross-functional workshop to develop Analytics design, metrics (real KPIs and metrics) and high-level requirements

DEFENSE BUSINESS BOARD

DBB Recommendations

Technologies and Systems:

- Halt and re-set all data and analytics systems acquisition and development until detailed user-driven requirements, return on investment (ROI) and time to value estimates are made

- Systems to be reviewed and assessed include Robotics Process Automation, extract transform & load (ETL), artificial intelligence (AI), etc. - starting with the data and then moving upwards

- Start on a process to rationalize and harmonize the mass of business information systems within the DoD, putting "teeth" into this with budgeting for new technologies and removing funding for old and redundant systems

- Consider changing the funding pattern of data and analytics technologies to follow the life cycle pattern of design-development-testing-implementation-maintenance-replacement

A Future Initiative?

To quote from a leading and innovative thinker we interviewed (and one with knowledge of technology in the DoD and the private sector):

> *"Everything companies are doing today can be described as linear improvement along the same flight path. What if there is a way to tackle the data accuracy, completeness and "intelligent" analytical issues to develop and implement standards, ensure data accuracy and completeness, and develop complex analytics and algorithms quickly? For example, like the COBOL initiative in the DoD?"*

This is a visionary initiative that could be funded on a research basis (somewhat like what is done in DARPA), **and is one that, with American ingenuity and innovation, will put the US and the DoD far ahead of its adversaries**

DEFENSE BUSINESS BOARD

DBB Recommendations Summary

Suggested Future Initiatives to Consider

Funding/Budget to manage Systems Dev
and Implementation
No Investment w/o Requirements, ROI,
Time to Value

Technologies and Systems

Business Information
Systems Rationalization
and reduction

"Front-Line" + Executive level
Strategic - Ops - Tactical

Analytics

Design Collaborative, multi-org,
multi-functional - "Big Data"
Descriptive-Predictive-Prescriptive

"Express Lane" and Hiring
Requirements
Digital Peoples' Officer?

People and Culture

Change Management Program
Value Proposition linked to
NDS Goals and Costs

Master Data Management/
Standardization
Ownership/Accountability

Data

Data Accuracy and
Completeness
Processes, Metrics

Empowerment
Formalization

Governance, the Chief Data Officer

CoE
Budget/Funding

"The Bottom Line" - Revisited

- While DoD is much larger and varied than private sector companies, the current urgency of increasing threats, technology development and expected additional resource constraints mean that data must be treated as a "strategic asset" and data management and analytics needs to be a top priority

- DoD has launched some initiatives **consistent with the leading practices in private industry** and it is making progress on its data challenges, however in terms of analytical capability, the DoD lags leading private sector practices by a wide margin. DoD leaders know what strategies are required, but the key is execution

- The CDO and Data Council must be empowered, formalized and made accountable for the data strategy, its operationalization and data quality. Data ownership must lie with the data originators and both analytics and data processes must start at the "front-line"

- Both civilian and military leadership need to be held responsible and accountable for implementing the overall data strategy. It needs to be part of the ongoing performance management, promotion, reward, and related processes

- The data strategy at the CDO and agency levels must be funded and budgeted

- A Change Management Program must be initiated from the very top to demonstrate the value proposition and linkage of data, collaboration and analytics to achieving NDS and cost goals, as well as unit and individual objectives

"The Bottom Line" - Revisited

- All key data needs to be automated using tablets, where appropriate, and manual record keeping needs to be discontinued by a specific date

- Sophisticated data analytics and AI capabilities will not be possible until the DoD can generate timely, complete, comparable and accurate data. In addition, an unmodified opinion of the DoD financial statements will not be possible until this criteria is met

- Dashboards should be based on the most vital data for key decision making, and should be a collaborative effort with the users

- DoD needs to upgrade its data management and analytical personnel using expedited hiring, appropriate requirements and enhanced training

- Enterprise Data lakes/pools (e.g., ADVANA) should be mandated for use in key decision making

- Existing financial/ERP systems need to be significantly rationalized and reduced with End-of-Life Dates established and funding adjusted

Terms of Reference

List of interviewees and Organizations

Task

The Deputy Secretary of Defense directed the Defense Business Board to:

- Assess the use of audit and performance data in the DoD

- Examine how audit and performance-related data and analytics are used by leading companies in private industry to gain insights and drive successful outcomes

- Provide recommendations to assist Department executives in optimizing decision-making to ensure their business outcomes are efficient and effective, now and in the future

DEFENSE BUSINESS BOARD

Task Specifics

The Task Group was specifically asked to address the following within the DoD:

- Review how DoD uses data, describe any major challenges in using it for decision making, and identify any clear opportunities for improvement based on private industry best practices

- As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD can change its business practices to be more efficient

- As we improve the quality of the financial statement and the underlying transaction level data, recommend how DoD decision-makers can best take advantage of this data

DEFENSE BUSINESS BOARD

Task Specifics

The Task Group was specifically asked to address the following from Private Industry:

- Examine how financial statement data and transaction level operational data is used in the private sector and how it could be applied to government (both for senior level decision making and for operational improvement

- Share/explain analogous, world class private sector examples

- Explain unique characteristics of the public sector that may limit or hinder application of private sector best practices and provide mitigation strategies, as appropriate

- Identify the leading private industry best practices of data management, analytics, dashboards, and decision processes

- Provide specific recommendations and options for the presentation, periodicity, and organizational level of reporting financial statement and transaction level data to inform decisions

- Provide specific recommendations and options for additional reform, to include tools and/or modifications to existing decision processes

- Any other related matters the Board determines relevant

DEFENSE BUSINESS BOARD

Interviews

Mr. Taka Ariga, Chief Data Scientist & Director, Innovation Lab, Government Accounting Office (GAO)

Mr. Corey Bean, Senior Manager, PricewaterhouseCoopers (PwC)

Mr. Jonathan Breul, former Executive Director of the IBM Center for The Business of Government; former Senior Advisor to the Deputy Director for Management, OMB

Mr. Michael Condro, Partner, Leader of US Audit Industrial Products & Construction (IP&C), Deloitte Touche Tohmatsu Limited (Deloitte)

Mr. Michael Conlin, Chief Business Analytics Officer, OCMO

Mr. Bob Dacey, Chief Accountant, GAO

Dr. Das Dasgupta, PhD, Chief Data Officer, Saatchi & Saatchi

Mr. Tom Davenport, President's Distinguished Professor of Information Technology and Management, Babson College; co-founder, International Institute for Analytics; Fellow, MIT Initiative for the Digital Economy; Senior Advisor, Deloitte

Mr. Dante D'Egidio, Assurance Managing Partner, US-East Region, Ernst & Young (EY)

Mr. Mark DiMaggio, Global Head of Basel Capital Measurement & Analytics, JP Morgan Chase & Co.

Mr. Mark Easton, Deputy Chief Financial Officer (DCFO), Office of the Under Secretary of Defense (Comptroller) (OUSD(C))

Mr. Carl Gerber, Chief Data Officer, Deloitte

Mr. Doug Glenn, Assistant Deputy Chief Financial Officer (ADCFO), OUSD(C)

Mr. Diwakar Goel, Vice President and Global Chief Data Officer, General Electric; Board Member, MIT Center for Information Systems Research (CISR) Advisory and Research, MIT Sloan School of Management

Mr. Thomas Harker, Performing the Duties of the Under Secretary of Defense (Comptroller)/CFO (PTDO USD(C)/CFO)

Ms. Sara Hay, Assistant Director for Advanced Analytics, Innovation Lab, GAO

HON Lisa Hershman, Chief Management Officer of the Department of Defense

Ms. Alaleh Jenkins, Performing the Duties of Assistant Secretary of the Navy (Financial Management and Comptroller); Principal Deputy Assistant Secretary of the Navy (Financial Management and Comptroller)(ASN(FM&C), Department of the Navy

Ms. Mobola Kadiri, Deputy Assistant Secretary of the Navy (Financial Operations), (DASN (FO)); former Director for Financial Improvement and Audit Remediation (FIAR) directorate, OUSD(C)

Mr. Asif Khan, Director, Financial Management & Assurance, GAO

Mr. Mark Kristall, Partner, Internal Audit, Compliance and Risk Management Solutions, PwC

Mr. Kristof Ladny, Senior Advisor for Financial Data Modernization, Assistant Secretary of the Army (Financial Management and Comptroller) (ASA (FM&C)), Department of the Army

Mr. Mitchell Lawrie, Director of Transformation & Reform, OCMO

Ms. Suzanne Leopldi-Nichols, President, Global Business Services, United Parcel Service

Mr. Greg Little, Senior Staff Accountant, Director, ADVANA Program, OUSD(C)

Mr. Richard Lombardi, Deputy Under Secretary of the Air Force, Management (SAF/MG), & Deputy Chief Management Officer, Office of the Under Secretary of the Air Force (SAF/US), Department of the Air Force

Mr. Larry Malenich, Managing Director, Financial Management and Assurance, GAO

Ms. Angela Mangiapane, President, Mars Global Services (MGS), Mars, Inc.

Dr. David Markowitz, Assistant Deputy Chief of Staff, G-8, Headquarters, Department of the Army

Mr. Arthur Marshall, Assurance Partner, US-East Audit Innovation and Digital Leader, EY

Mr. Christopher Mihm, Managing Director, Strategic Issues Team, GAO

Mr. Jonathan Moak, Principal Deputy Assistant Secretary of the Army (Financial Management and Comptroller), Department of the Army

Dr. Donald Moynihan, McCourt Chair at the McCourt School of Public Policy, Georgetown University

Mr. Denis O'Leary, Associate, JP Morgan Chase & Co.

Dr. Tim Persons, Chief Scientist & Managing Director Analytics team

Mr. Azra Rebronja, JP Morgan Chase & Co.

Dr. Silvan Rubino-Hallman, PhD, Director, Transformation & Reform, OCMO

Mr. John Short, Partner, Federal and DC Area, EY

Mr. Lorenzo Smith III, CFA, Private Banker, JP Morgan Chase & Co

Mr. Dave Spirk, Chief Data Officer (CDO), Office of the DoD Chief Information Officer

Ms. Jacqueline Tame, Chief Performance Officer, DoD Joint Artificial Intelligence Center (JAIC), OUSD(C); GAMECHANGER, ADVANA NLP

Ms. Lorin Venable, CPA, Assistant Inspector General (AIG-FMR), Office of the DoD Inspector General

Dr. Casey Wardynski, Army Assistant Secretary of Manpower and Reserve Affairs (ASA (M&RA)), Department of the Army

Mr. Mark Weinberger, Former EY Global Chairman and CEO

Prof. Barb Wixom, Principal Research Scientist, MIT CISR

Deliberations and Vote
Audit Performance Data Usage in Private Industry Study

Defense Business Board

TAB D

INTERVIEWS CONDUCTED

TAB D - Interviews

Mr. Taka Ariga, Chief Data Scientist & Director, Innovation Lab, Government Accounting Office (GAO)

Mr. Corey Bean, Senior Manager, PricewaterhouseCoopers (PwC)

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Defense Business Board

TAB E

QUESTIONNAIRE

DEFENSE BUSINESS BOARD

Interview Questions   Aug 19, 2020

1. What is your experience with the audit process (inside & outside DoD)?

2. How have you used audit data, other data and analytics in the past to assess operations, processes, conflicts of interest and make decisions and improvements? Can you give us some of your management principles and examples?

3. What are your key wants and needs regarding audit data analytics?

   a. Your expectations for the Audit in terms of data, outcomes, decision-making, insights?
   b. How can or should DoD change its business practices to improve its ability to obtain, analyze and use data to increase efficiency and drive outcomes?
   c. What are the business processes most people view as broken inside DoD? Those that can be improved through audit and performance data analysis?
   d. Can you identify any obvious areas for improvement in using and analyzing the audit data? Specific functional areas(e.g. Acquisitions, Contractor/Consultant Hiring, etc.) or Agencies?
   e. What kinds of transactional data (if we got it right) could or should the audit provide that would be a game changer for decision making inside DoD?

4. In your organization today:
   a. How are the audit results communicated to your organization?
   b. What analytics or data visualization are used?
   c. What is the process for accountability in regards to responding to audit findings?
   d. Does the FIAR governance model work effectively? What, if any challenges inside DoD make it's mission more difficult?
   e. How could Auditors collect data more effectively and efficiently?
   f. How often do we present the data to various leaders?
      I. Who does the data go to?
      II. Is there a separation of performance measures that continue to increase and granularity as they move down the ladder.

5. What are the biggest challenges you see in performing the audit, analyzing the data and acting on it?
   a. Data - Incomplete data, incorrect data, lack of data, etc? DoD
   b. Management/Leaders- how are DoD Leaders not *currently* using the audit but should be?
   c. Resistance to change from Agencies and their personnel involved in improving business processes and effecting transformation?
   d. Technology, Practice and Visualization?

       e.   Data dissemination?
       f.   Follow-up and accountability?
       g.   Conflicts of Interests?
       h.   Others?

6. When you think of Private Sector effectiveness and efficiency, and their use of data driven decision making, what companies or practices/methodologies come to mind and why?
    a.   Do you think that Government agencies have differences in culture, structure, regulations that would hinder the adoption and implementation of these practices?

7. If you could imagine a future state where data and analytics drives DoD insights and decision making, what does it look like? What is your vision of the future state?
    a.   Access to data?
    b.   Periodicity of data capture & reporting?
    c.   Analytics and data visualization used?
    d.   Levels of the organization that receive data?
    e.   Outcomes and Insights you want to achieve?
    f.   Presentation of data – control towers, smart phones, tablets, cloud-based tools?

8. The DoD spent $XXXm in performing its 2019 Audit. Should it measure ROI on Data and Analytics?
       a.   If so, how?
       b.   What is the definition of Return, if any?

9. In a large organization, should Business analytics be under a single executive or multiple executives conducting their own organizational and functional analytics from a common audit and performance data database?
    a.   What, in your mind, are the pros and cons of the different approaches?
10. In a large, multi-BU organization, should the Chief Data Officer position be under a single executive, or multiple executives in the different BUs/organizations managing their own data under a single strategy and architecture?
    a.   What, in your mind, are the pros and cons of the different approaches?
11. Who should set the data and analytics strategy in a large, multi-BU organization?
    a.   A single central executive, a group of BU/organization executives working together and jointly? Or individual BU/organizations?

Interview Questions   Aug 19, 2020

General:

1. How has your company progressed in using audit and performance data analytics to drive business improvement, make transformative changes and inform strategy?
2. Do you benchmark your data analytics capability against best in class or competition?
3. How do you measure success in using internal data analytics to drive business outcomes?
4. Can you identify any obvious areas for improvement in the audit data capture and analytics process ? Any specific functional areas or business units?
5. Does your analytics of your audit and performance add value? How, why?

Current State:

6. Describe the process your company uses in internal audit (financial statement and transactional data) and performance data analytics to:
    a. turn data into action?
    b. present the data? To whom? Just the C-suite or SVP/ BU/LoB leadership level or is there a separation of performance measures that continue to increase and granularity as they move down the ladder. How often is this data presented to the leadership?
    c. hold business unit and functional heads accountable for audit findings and using the data?
    d. improve processes, find efficiencies, reduce costs, drive revenue, improve customer service or improve productivity?
    e. inform strategic thinking?
    f. Communicate the results to your organization?
7. How do users access data, and how often is data captured & reported?
8. What dashboards do you use to manage and drive the business?
    a. What levels inside the organization use them?
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Future State:

12. How do you imagine your dashboards will evolve over the next few years to keep up with industry and technology trends?
13. The DoD wants to understand how thought leaders like yourself envision the future state of audit data and subsequent analytics.
    a. How, when, what and who uses the data analytics platform.
    b. What kinds of things does it enable you to achieve? And with what benefit?
    c. How does the presentation of data happen in a future state, -what medium?

Examples that you know of:

14. What are some remarkable stories that demonstrate how either your company or others you know used transactional or operations level data and analytics to make significant improvements or game-changing decisions?
15. Which companies are using their audit and performance data as well as subsequent data analytics effectively?

Interview Questions   Aug 19, 2020

General:

1. How has your company progressed in using audit and performance data analytics to drive business improvement, make transformative changes and inform strategy?
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Version PS C-S, LoB, IA DA

Advance questions for Service CMOs

Background/History
- We're interested in any background perspective you can offer in terms of how DoD, and more specifically, your service has traditionally used data in the past for decision making.
- Are there any challenges DoD and/or your service has had in the past to source and use data for decision making?
- What areas or types of data is DoD not capturing from your service but should capture?
- Congress has been asking DoD to perform financial audits for over 20 years. Why has it taken so long for DoD to initiate this process?
- What are your service's biggest challenges in performing the audit -like incomplete data sets, lack of data integrity in comparison?

The DoD Audit
- As DoD improves its capability to capture more and more financial transaction data, what kinds of opportunities does this present for DoD to modify and improve business practices inside the services?
- How could the audit data be used to identify new opportunities for DoD to find efficiencies inside its services?
- As the audit expands its scope and capability to capture more data over time, how can you foresee this being used to improve the decision making process at the higher levels?
- Many decision processes inside DoD seem to take forever to complete. Which of these are unnecessarily long (& important) and how could access to more & faster data improve the speed of the decision cycle?
- Does DoD's implementation of this annual audit create opportunities to capture data not previously being captured and to use it to bolster reform/efficiency efforts?
- To your knowledge, have auditors said that they wanted certain financial or transactional data that DoD doesn't currently collect?

DoD Systems
- Some senior leaders suggest that service branches do not like to share data with the enterprise (DoD). Should all DoD entities be required to provide Advana access to their data?
- Why is it so hard to get entities inside DoD to agree to use just one source of data?
- How wide-spread is the use of dashboards? What tools does your service use?

Private Sector
- In the past decade, the Private Sector has made giant investments in Data Analytics in an effort to turn raw data into an asset that enables them to compete & win in the marketplace. DoD has made progress in using its data, but needs improvement.
  - What next big steps can DoD and/or your service take in data analytics to perform better?

Data Analytics
- In what areas does DoD need to improve its audit process as well as the use of the audit data? Are there any areas where your service feels its audit process is strong?
- What challenges are preventing DoD from capturing all of its enterprise-wide financial transactions inside ADVANA?
- What is your plan to modernize your service's ability to utilize audit and performance data similar to Fortune 50 companies?

Defense Business Board

TAB F

LITERATURE REVIEW

TAB-F – Literature Review

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Defense Business Board

TAB G

ACRONYMS

TAB G - Acronyms

ABT	analytic base table
ADVANA	Advanced Analytics
AI	artificial intelligence
AP	account payable
BU	business unit
CDO	Chief Data Officer
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
CIO	Chief Information Officer
CoE	center of excellence
CPS	Cyber-Physical Systems
DAFA	Defense Agencies and DoD Field Activities
DBB	Defense Business Board
DepSecDef	Deputy Secretary of Defense
DMAG	Deputy's Management Action Group
DoD	Department of Defense
ERP	enterprise resource planning
ETL	extract, transform, load
FACA	Federal Advisory Committee Act
FIAR	Financial Improvement and Audit Remediation
GFC	global financial crisis
HR	human resources
IoS	Internet of Service
IoT	Internet of Things
KPI	Key Performance Indicators
MilDep	Military Department
ML	machine learning
NDAA	National Defense Authorization Act
NDS	National Defense Strategy
OSD	Office of the Secretary of Defense
P&G	Procter & Gamble Company
PAS	Presidentially Appointed, Senate-Confirmed
PPBE	Planning, Programming, Budgeting, and Execution
Pub. L.	Public Law
QR	quick response
ROI	return on investment
RPA	robotics process automation
SecDef	Secretary of Defense
SOX	Sarbanes Oxley Act audit requirements
TG	Task Group
ToR	Terms of Reference
U.S.	United States
U.S.C.	United States Code

Defense Business Board

TAB H

PUBLIC COMMENTS

TAB H – Public Comments

No public comments were received in the course of this Study.

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