

Innovation and Emerging Technologies in Government: Keys to Success



Dr. Alan R. Shark
Executive Director,
Public Technology Institute
(Now part of CompTIA)



IBM Center for
The Business of Government

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“ People don't often think of government as a place for innovation and risk, but the opportunities are there. ”

Dr. Alan R. Shark

Foreword

On behalf of the IBM Center for The Business of Government, we are pleased to present this special report, *Innovation and Emerging Technologies in Government: Keys to Success*, by Dr. Alan R. Shark, Executive Director, Public Technology Institute.

The obstacles to implementing technological innovation in government often have less to do with hardware and software than people and processes. How can leaders recognize the need for new technology? How can innovators find funding and put the pieces in place to test a new idea? How does an agency define and measure success?

This report describes federal, state, and local innovations in action that address these practical questions. The author offers inspiring examples of how innovators are adapting emerging intelligent automation technologies, including blockchain, artificial intelligence, and cloud computing. Moreover, the report distills key qualities that drive successful innovation. Based on numerous interviews with leading innovators in government, Dr. Shark observes: “People don’t often think of government as a place for innovation and risk, but the opportunities are there.”

We hope the interviewees’ stories about using technology in their organizations to improve the lives of Americans provides a useful blueprint, helping innovators and their teams across government to learn about and apply emerging technologies in ways that drive mission success.



Daniel J. Chenok

A handwritten signature in blue ink, appearing to read "DJA".

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Introduction

Federal, state, and local governments spend over \$200 billion annually on information technology (IT) that supports thousands of systems providing services to the public, the business community, nonprofits, and other key partners. Most funding goes toward maintenance and some towards IT modernization. However, there is no way to identify the amount spent on research and development or innovation and the use of emerging technology. The general public often only hears about IT projects that fail, project cost overruns, massive delays, and questionable means for measuring performance.

Just beneath the surface of routine government IT operations lie hundreds if not thousands of pockets of innovation. Ample evidence shows a growing network of exceptional technology leaders who possess the vision, drive, and multilevel competencies to bring about improved systems to make government more efficient. And these leaders are equally mindful of the need to better serve the public as a customer, including better customer experience or moving beyond simply improving an online service. The leaders and innovators highlighted in this special report have all demonstrated their understanding of how complex systems work while actively seeking innovative ways toward improving them.

The report describes innovation in action and the use of emerging technology, looking at the qualities that each of the interviewees displayed that drive successful innovation. The leadership stories provide a useful blueprint to help those in government to learn, improve, and perhaps better appreciate their tech toolkit inventory. But tools must not only be recognized and understood—they need expert “mechanics” to get the most out of them. Moreover, an ordinary mechanic can transform to become an expert by applying the five innovation mindsets demonstrated in these stories, highlighted in the last section of this report.

Methodology

The author initially identified a few dozen government agencies known for applying innovation and emerging technologies. Based on scheduling and individual availability, the field was narrowed to nine agencies. One surprise was that many of the in-depth interviews revealed other pockets of innovation within their organizations, which led to additional interviews. A general interview guide helped frame the interviews and provided each interviewee with an overview of the report's goal and questions that would be asked. The resulting consistent pattern of innovation and self-motivation described here is nothing less than inspiring.

This report includes high-level IT executives at nine government entities: seven agencies from the federal government, one state, and one local government.

They are:

- General Services Administration
- Department of Health and Human Services
- National Oceanic and Atmospheric Administration
- Department of Veterans Affairs
- National Science Foundation
- U.S. Agency for International Development
- U.S. Census Bureau
- State of Utah
- Sonoma County, California

Many thanks to the 13 innovators who gave their time and readily shared their stories and insights.



The Emerging Technologies Toolbox

The emerging technologies observed here are not necessarily new but the applications continue to grow in complexity. Each of the emerging technologies are discussed below—five central technologies, of which at least four appeared to be common to all 13 interviews:

- Artificial intelligence
- Blockchain
- Hybrid cloud technologies
- Advanced data management
- Data analytics

Artificial Intelligence

The term “artificial intelligence” is not a single technology. It is a branch of computer science that trains machines to perform cognitive human tasks such as perceiving, learning, reasoning, and solving problems. It spans a field of different types of technologies that are used for different purposes.

Types of technologies include machine learning, natural language processing, and deep learning. Types of purposes include fraud detection (machine learning), call center responses (natural language processing), retrieving orders in warehouses (robotics), managing construction projects (automated planning and programming systems), and processing insurance claims (rule-based expert systems).

The rapid growth, development, and use of AI in recent years derives from newly available massive computational power, data storage and management capabilities, and novel technology frameworks like neural networks. AI can be highly useful in identifying patterns, seeking out anomalies, making real-time recommendations based on data inputs, and communicating both verbally and in writing. At the same time, it will continuously learn and perfect its algorithms to support human decision making. Some have stated that AI is more about “augmented intelligence” as opposed to “artificial intelligence.”

Currently, AI primarily focuses on performing specific tasks called “narrow” AI. While narrow AI may be very proficient at a specific task it is unable to perform work outside of that task without significant redesign. Researchers are investigating “broad” AI that would be able to respond to a wide range of tasks and topics and behave much more like human intelligence. Broad AI would be able to operate between diverse domains such as science, arts, economy, and environment.

Blockchain

Blockchain creates trust because it represents a shared record of the truth. Data that everyone can believe in will help power other new technologies that dramatically increase efficiency, transparency, and confidence.

Blockchain, often confused with Bitcoin, is a technology and process for managing data and digital assets. It can be characterized as a public decentralized and distributed ledger technology that records historical transactions of any asset or currency. It functions as a peer-to-peer community network via a consensus-driven process. It is the technology behind cryptocurrencies.

Blockchain is viewed as a highly secure and unalterable database that acts as both the information and the conduit. The key to its security advantage is that it automatically creates an audit trail that makes it appealing for reconciliation purposes of historical records, transactions, and regulations that will impact a whole host of future government functions and services.

No participant can change or tamper with a transaction after it's been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.

Hybrid cloud technologies

Hybrid cloud is a computing environment that connects an organization's on-premises private cloud services and a third-party public cloud into a single, flexible infrastructure for running the organization's applications and workloads.

The principle behind hybrid cloud is that its mix of public and private cloud computing and storage resources—with a level of orchestration between them—gives an organization the flexibility to choose the optimal cloud for each application or workload (and to move workloads freely between the two clouds as circumstances change). This enables the organization to meet its technical and business objectives more effectively and cost efficiently than it could with public or private cloud alone.

Advanced data management

Governments at all levels have a legal obligation to collect and store data and information. For example, the U.S. Constitution requires that a census be taken of the populace every 10 years. For citizens, data collection begins at birth with the issuance of a state-issued birth certificate and a federally-issued Social Security number. State governments issue driver's licenses and the federal government issues passports, among other points of government-led data collection.

The federal government has designated 13 agencies whose principle mission is to collect statistics. However, every federal agency collects data in one form or another. For example, the National Oceanic and Atmospheric Administration (NOAA) collects more real-time data than any other agency in the U.S.

Data has become the foundation for innovation and decision making. With the advent of super computers and the ability to retrieve data from anywhere in the world in microseconds, data analytics is the fundamental tool for decision making, modeling, and reporting.

While data management is not necessarily new, the way data is mined and applied has changed. Basically, data management ensures that an organization's entire inventory of data is accurate and consistent, readily accessible, and properly secured. What adds to the complexity of these tasks is the amount of data, the speed of data, and the various new sources of data—both structured and unstructured data (e.g., audio, video, social media, and telemetry). Research shows that in 2018, more than 2.5 quintillion bytes of data were created each day. That's 2.5 followed by 18 zeros!

In 2020, the Office of Management and Budget finalized its Federal Data Strategy Action Plan, which provides a common set of data principles and best practices for implementing data innovations to drive more value for the public. There are now 20 action steps in the current version to guide the management of federal data.

Data analytics

Data analytics is the science of analyzing raw data in order to draw insights from that information. Data analytics oftentimes depends on techniques and processes that have been automated. They play an essential role in helping organizations maximize the value of their data by allowing decision makers to unearth insights, develop plans, and respond in real time to citizen demand.

Data analytics techniques include both descriptive and advanced analytics. Descriptive analytics address questions such as "what has happened?" Advanced analytics—which increasingly is relying on AI—attempts to reveal trends hidden in the mass of information and to make predictions about future direction.



Close Ups With 10 Cutting-Edge Technology Innovators

This section presents ten examples of innovation and innovators. Each agency or department lead was passionate regarding their organization’s accomplishments, and each displayed a strong dedication towards serving the public good. The following summaries draw from many hours of conversations that took place in an interview format.

General Services Administration

The General Services Administration (GSA) sets governmentwide policies on operational matters and, on a cost-reimbursable basis, provides other federal agencies the real estate, professional services, and products they need to deliver on their missions. Recently celebrating its 70-year anniversary, GSA is also seen as a catalyst for innovation across the government.



David Shive is the chief information officer for GSA. He also has been selected by his peers to serve as the vice chair of the governmentwide CIO Council.

He has been a champion of GSA being at the leading edge of adopting new technologies and approaches so it can demonstrate their value to other federal agencies. For example, GSA was the first agency to have the internet on every desktop. Six years ago GSA began using cloud technology, and today its cloud utilization is 53 percent and growing.

Shive observed: “Going back to 2011, the thinking at the time was we’re big enough that the things we do are a good analog for large scale transformation

at a place like Commerce or DHS and similarly large agencies. But we're small enough that we can be pretty nimble and agile and try stuff out. And if we fail, it's not going to fail at the federal enterprise layer level. It's going to fail at a reasonably manageable size."

He has been quick to point out that much of this philosophical strategic approach to innovation and technology started with his predecessor, and he basically carried on the innovation framework to this day.

GSA was among the first agencies in government to adopt the use of cloud-based collaboration tools for internal use. And the users loved them. They could access data from multiple devices from multiple locations just about anywhere. This was considered highly innovative at the time. And in the current pandemic, it was crucial to continuity of operations.

GSA steadfastly positions itself to be the "innovation proving grounds" for the federal government. Once the agency validates the value of a new tool or product by using it internally, it then has the credibility to reach out and meet with the heads of the business areas in other agencies to share its toolbox of solutions that are proven to work.

When asked about measuring results against stated goals, Shive responded that goals and timelines are useful guideposts, but prefers not to use them as rigid performance targets. He says that experience has demonstrated that focusing on complying with overly rigid timelines can lead to inefficient or ineffective outcomes. By adopting agile principles—which prioritize rapid turnaround, iterative development, and working closely with customers—creates a more productive organizational culture.

According to Shive, change management plays a large role when it comes to fostering an innovation-focused culture. Over the years he has worked diligently to earn the trust of his and other staff within GSA and externally as well. His approach is to start small and then demonstrate a proof of concept before moving to an expanded (larger) version.



When promoting a new innovation or technology application internally or with other agencies, Shive made it clear that GSA's approach is not just to install new technology. It also recognizes the people dimension as well by offering training and reskilling for staff who work on legacy-related systems. Emerging technologies, such as artificial intelligence, machine learning, and robotic process automation, can automate repetitive processes that do not require human reasoning. This allows staff to focus on more meaningful cognitive work to better meet mission requirements. Shive notes: "We're seeing people able to free up more time to do innovative work elsewhere and improve mission-related turnaround time for tasks."

Shive says his next major project is digital transformation—to integrate digital technology into all aspects of GSA's business and fundamentally change operations and deliver value to its customers. This not just about shedding outdated processes and practices, but changing GSA's operating culture so that it constantly experiments, challenges the status quo, and grows comfortable with taking informed risks. This will be done by expanding its use of automation technologies and integrating cybersecurity into all IT development and operations as part of the transformation process.

In addition to GSA IT, GSA houses many other teams and programs that foster the use of innovation across the government, like 18F, the Presidential Innovation Fellows program, the cross-agency Centers for Excellence, and 10x.



GSA's 10x Program: An Employee Suggestion Box with Results

This group funds, supports, and develops ideas from federal employees about how technology can improve the public's experience with the government. Based on private sector venture capital investments models, 10x is an incremental investment fund inside the federal government. The group funds internal projects that can scale across the federal government or significantly improve how our government builds technology for the public good. Given 10x's unique role both at GSA and serving all federal agencies, it is worth taking a deeper look into what they are all about.

Nico Papafil serves as the director of 10x. Before assuming the director role, Papafil served as the program's Operations Lead and has held a variety of roles also within GSA. He is the co-founder and co-creator of 10x and likes to think of 10x as the "federal venture studio," and has navigated among a few federal departments, including the GSA's White House Service Center (WHSC). There he was tasked with instituting a time tracking system for the WHSC wage grade employees servicing the White House property. This was his opportunity to start looking at performance metrics, which brought him to GSA's Technology Transformation Services (TTS), where he examined different performance evaluations and how they were measuring impact. While working in the TTS Front Office, he came in contact with what was then a one-time event called The Great Pitch. This project was designed like the popular TV show Shark Tank and funded by the Digital Services Fund providing discretionary funds for new, good-for-government products and services. More than 100 ideas were submitted, and like the TV show, they had a panel of government subject matter experts, called "sharks," who evaluated ideas presented by federal employees for how they wanted to use technology to improve government. Papafil found of particular interest the fact there were problems that occurred having to do with outcomes and performance evaluations. He learned that some projects never kicked off and other projects spent money with no discernable results. Some projects turned out to be very impactful and are still being used and adopted to this day. After the one-time Great Pitch event, Papafil stayed on with the program to iterate the process, which eventually turned into today's 10x.

Innovation occurred at this point because Papafil and his co-founder saw a problem and developed a vision. Their vision was to grow a one-time event into an ongoing program with much greater ongoing accountability. Four years later, 10x is still going strong. The program solicits and funds impactful, scalable projects that improve the public's experience with government, and that also can be replicated across government agencies. The program now takes a phased funding approach, which means only some ideas are selected for funding past Phase One. Each Phase has a set dollar ceiling amount and milestone deliverables to make them measurable, which helps the 10x staff to mitigate risk and perform due diligence. If an applicant's idea makes it to Phase One, they have to go through more rigorous steps to qualify for Phase Two, giving them a nice incentive for additional funding. The program is competitive as some never make it to Phase One, or if they do only a few go on to Phase Two. This process highlights how 10x uses a lean methodology by applying a small amount of seed funding in the early stages of a project and then gradually increases the funding amount as projects move through their innovation pipeline. The program has been a huge success for GSA.

Department of Health and Human Services

The Department of Health and Human Services (HHS) is responsible for administering programs that ensure the health and well-being of the American public. One tool used to accomplish this is the major focus placed on health information technology (health IT). The department makes almost one-fourth of all federal government expenditures and administers more grant dollars than all other federal agencies combined. HHS' grants spending was one reason it was recently assigned the responsibility of operating the Grants Quality Services Management Office (QSMO) for the entire federal government.

HHS has 11 operating divisions, including eight agencies in the U.S. Public Health Service and three human services agencies. These divisions administer a wide variety of health and human services and conduct life-saving research for the nation, protecting and serving all Americans. There are 13 offices that report directly to the Office of the Secretary that assist with enterprise support for the department's mission, including the Office of the Chief Information Officer. HHS also provides IT project management and oversight for all major IT projects that have enterprise importance. For the purposes of this report, innovation within IT is the focus.



José Arrieta was appointed as the chief information officer (CIO) for HHS in 2019, where he provides leadership and oversight of the department's \$6.3 billion IT portfolio. He is currently serving as the interim chief data officer (CDO) as well. It's perhaps important to note Arrieta's background has not been tied solely technology. He has 15 years of prior expertise in policy and high-level procurement that included IT acquisition. He ran the largest contracting vehicle in the world as a revenue generating entity within GSA. During that time, he ran a proof of concept using blockchain technology that infused artificial intelligence (AI), a first for the federal government. He also spent time working within the intelligence community working on programs that developed redress systems to identify terror threats around the world. Building security platforms would help him later on in his relatively young career.

Upon his arrival at HHS, Arrieta was tapped to participate in the ReImagine HHS Initiative, which leveraged funds focused on modernization to support accelerated adoption of AI, cloud computing, blockchain, and other emerging technologies. This fund was used to help build one of the first blockchain platforms in the federal government. He is a huge proponent of blockchain technologies and has demonstrated that it not only works, but helps reduce the need for maintaining centralized technology support systems. The model he discussed was building a series of micro services off the blockchain. Then each individual disparate ecosystem would be able to run its own system and could manage its own micro services.

During the COVID-19 pandemic, his team built HHS Protect, a database that supports the COVID-19 response efforts by Dr. Deborah Birx, one of the top advisors appointed by the president to the COVID-19 Task Force. The team assembled data that drive her presentations to date, based on HHS Protect. This platform includes data from 6,200 hospitals, 3.0 billion data elements, and data from all 50 states, plus all six U.S. terri-

tories, including all laboratories, all case information, and all of the diagnostic information that exists in the United States. HHS Protect, with this wealth of timely and critical data, was created in days—not years.

Recognizing the role blockchain can play, Arrieta is actively considering a plan that will take the information contained in HHS Protect and ultimately develop a network of nodes to distribute data in a secure matter. The bottom line for him is that while blockchain was developed to instill trust in trades between anonymous partners, its design instills trust in underlying datasets because they are immutable. He views data as the single most important asset and wants it to be an immutable record of underlying datasets and data elements. He also wants to eliminate the cost burden of constantly replicating data as it moves into different databases. And that is where the value of blockchain comes into play.

HHS has developed four functioning blockchain projects since Arrieta came aboard, showing strong use cases for blockchain that demonstrate lower costs and deduplication of data. The blockchain efforts eliminate moving the same dataset between multiple databases in a very siloed environment, addressing what Arrieta found at HHS.

In sharing his experience, Arrieta claims to have learned much along the way—for example, forcing a focus on human-centered design. When asked about data quality and accessibility, he responded “we were collecting data from single sources of truth that already exists.” In less than three months his team built a system that houses three billion data elements, has 200 users, and this is largely driving the COVID-19 response. HHS created connectivity within an ecosystem so that first responders do not have to log in to 200 different systems to do analysis on how the virus is spreading within a given state.

In terms of drivers of innovation and where the process begin, Arrieta believes this can only occur if somebody understands and outlines the fundamental limiting factors that affect an agency, industry, or company. To him it’s all about having the curiosity to improve on business processes, then stepping back to take a critical view in solving problems. He will next apply this approach to data analytics and AI.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) collects more data in a day than any other civilian organization in the U.S. Celebrating its 50th anniversary this year, the agency constantly measures and monitors weather and climate; operates earth observation satellites; works to maintain the health of fisheries and marine mammals; and conducts real-time monitoring of the nation’s tides and ocean conditions. NOAA’s products and services support economic vitality and affect more than one-third of America’s gross domestic product. The agency’s overall mission is to predict changes in climate, weather, oceans, and coasts, to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources.





Zach Goldstein is the National Oceanic and Atmospheric Administration's (NOAA) chief information officer and director, High Performance Computing and Communications. In this position, he leads implementation of statutory requirements regarding the acquisition, management, and use of NOAA's information and information technology resources, to include NOAA's high-performance computing and communications infrastructure. Goldstein was named NOAA's CIO in January of 2015. His career encompasses more than 30 years of experience in information resource management in the federal government and private sectors.

Early in Goldstein's career he recognized the value of data and saw the improvements being made in data processing. He has helped to guide the wave of big data and data analytics as he also leads the High-Performance Computing and Communications (HPCC) function within NOAA. He sees innovation intertwined with change management, and believes in leading by example and bringing people together to solve common problems and challenges—providing a collaborative atmosphere towards experimentation.

NOAA is a unique agency as a scientific body infused in the nation's daily lives, and the agency also heavily depends on technology. One example of NOAA's technological innovation is the way they recognized an issue with distributing their data for commercial use, developing an economic and technological solution to meet customer needs and prevent strain on NOAA infrastructure. For example, a company wanting to utilize NOAA's weather data teamed up with a systems integrator to see how they could gain access to data already paid for by the public. Throughout the discussions with NOAA, the parties agreed that the best path forward would be for NOAA to put all relevant data in the cloud. This innovation would enable the company and integrator to access and process the data in the cloud in the same ecosystem.



A second innovation that impacts economics of data came when senior NOAA staff suggested instead of NOAA paying for the cost of putting what they needed into the cloud, the companies could pay. While federal policy prevents agencies from making money off of these kinds of endeavors, NOAA realized that it would cost a lot of money to run and maintain the cloud data system. This approach to financing is a novel idea that had rarely been tried in government, especially in a way that allows private sector companies to still monetize their products. So, while NOAA maintains complete control of its primary data processing and dissemination missions, and the data that was gathered and generated at taxpayer expense remains free to the public, they have shifted part of the cost of supporting the private sector data uses—thus avoiding significant infrastructure expenses to support increasing commercial use of NOAA data.

NOAA is well along in developing a comprehensive AI strategy, doing so by bringing input from across the agency. Through innovative leadership they are already seeing some positive results. NOAA staff know which variables need observation to feed the algorithms. They take the science and turn it into algorithms, which run using masses of data. This approach has benefited from significant investment over the years gathering specific environmental data, because the knowledge is derived from the weather itself. Mastering their data strategy first has made absolute sense.

Department of Veterans Affairs

The Department of Veterans Affairs (VA) provides vital services to America's veterans. VA provides health care services, benefits programs, and access to national cemeteries to former military personnel and their dependents. The department carries out its duties through three main administrative divisions: Veterans Benefits Administration, Veterans Health Administration, and National Cemetery Administration. VA employs more than 380,000 people at hundreds of medical centers, nursing homes, benefits offices, and national cemeteries throughout the country. VA operates the country's largest health care system with more than 1,400 health care facilities.

Kshemendra Paul serves as the chief data officer and executive director for Data Governance and Analytics for the VA, and has been in this role since late 2019. He provides business intelligence capabilities and an authoritative clearinghouse of information and analysis to inform VA-wide decision making. He describes his role as an in-house management consultancy that helps drive enterprise-wide capability, through a series of different data initiatives such as the VA's financial management and supply chain systems.



Before joining VA Paul served as the cloud action officer for the Department of Homeland Security (DHS), helping coordinate efforts to migrate information technology assets to cloud management platforms and optimize data centers. Prior to DHS he served as the chief enterprise architect at the Office of Management and Budget, where he provided governmentwide leadership in better aligning the government's IT infrastructure with mission goals. Before the federal government he worked in a variety of private sector technology ventures.

Paul's office is organized into three groups:

- The first group is the National Center for Veterans Analysis Statistics, which serves as the corporate analytic function for VA.
- The second group focuses on data governance and reporting functions. This group is responsible for data governance and policy work, including privacy and mission support activities. The data governance group also focuses organizational innovation, including the development of new pathways to collaborate around data as a strategic asset and managing the data process lifecycle.
- The third group develops the enterprise information architecture for the department business and data systems.

Paul views data as a strategic asset and points to the VA's Million Vet Program as a good example of the use of big data to develop insight and innovation. Given the VA's scale—with more than nine million patients—it can combine detailed clinical records with genomic information, creating a dataset that accesses unique survey data plus genomic information. The dataset currently has detailed longitudinal clinical information for approximately 850,000 veterans with a goal to reach one million; petabytes of data are stored at the Oak Ridge National Laboratories. Paul cites this as but one example of

driving innovation by data and curious minds. This work continues, and the VA now leverages Oak Ridge's supercomputers to apply AI to these data via about 45 active research projects.

Paul points out that many of VA's data-based innovation initiatives are oftentimes adopted elsewhere, a prominent example of which is its "Blue Button" electronic medical record launched in 2010. Blue Button enables more direct consumer access to personal health information by adding a "Download My Data" button to patient portal systems. VA developed the Blue Button capability in collaboration with the Centers for Medicare and Medicaid Services, the Department of Defense, and the Markle Foundation's Consumer Engagement Workgroup. The innovative functionality of Blue Button has since spread beyond VA to other government agencies as well as the private sector.



VA's realignment of many services around the experiences of veterans and their families in order to create a single face to the veteran demonstrates another example of this approach. More broadly called customer experience (CX), the new automated systems allow for benchmarking and better engagement with veterans. According to Paul: "The VA's [customer satisfaction] numbers stand up to almost anybody, private sector, other public agencies in some of our lines of business, our numbers are like 10 points, 15 points more than the private sector began. Many think of the VA as big and bureaucratic and certainly one of the largest in government. But you know bureaucracies respond to data management and the CX scores have been critical towards keeping folks apprised of all the good work the agency does."

Paul believes that much good work at the operational levels VA continues despite the turnover at higher levels as teams continue to strive to do things better through innovation—something the public doesn't really see.

National Science Foundation

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense." NSF funds approximately 25 percent of all federally supported basic research conducted by America's colleges and universities. In many fields such as mathematics, computer science, and the social sciences, NSF provides the major source of federal backing.

NSF's mission includes support for all fields of fundamental science and engineering. The agency is tasked with keeping the United States at the leading edge of discovery in areas from astronomy to geology to zoology. So, in addition to funding research in the traditional academic areas, the Foundation also supports "high-risk, high pay-off" ideas, novel collaborations, and numerous projects that may seem like science fiction today but which the public will take for granted tomorrow. And in every case, it ensures that research and education are integrated so that today's revolutionary work will help to training tomorrow's top scientists and engineers.

Dorothy Aronson serves as NSF’s chief information officer (CIO) and also serves as its chief data officer. She is the principal advisor to the Foundation’s Director and other senior management on all matters involving information technology (IT). Aronson oversees policy and governance for the efficient, effective use of IT resources to accomplish the Foundation’s mission, and she has been with NSF for 12 years.



NSF not only funds innovation—the agency lives it. For example, NSF draws on advanced technologies to solve a persistent challenge in the grant-making community of linking duplicative and overlapping research across grant-making scientific research organizations. To do this, the agency uses machine learning, data science, and distributed ledger technology (aka blockchain) infrastructure to build a Grants Community Blockchain (GCB).

The GCB was piloted on a set of research portfolios to successfully build a fingerprint (the key “block” in the “ledger”) and prove that comparing fingerprints reveals overlapping research proposals. In doing so, they “liberated” the proposal data while at the same time protecting proposal contents including intellectual property of merit and sensitive information. Aronson says: “We soon hope to have tools that can help alert program offices when overlaps occur, helping them connect and make the right decision before the grant is issued.”

Aronson modestly says that this was not her idea, and gives credit to a systems architect that she has been working with. However, from the perspective of an outside observer, the idea would most likely never have moved forward without her leadership, knowledge and professional standing with other agencies involved in the project. Specifically, in the spirit of a private sector entrepreneur, she approached GSA’s 10x program for seed funding. GSA saw the potential and provided some initial funding, just enough to develop a proof of concept. The agencies found a partner within the National Institutes of Health (NIH), which had been working on similar efforts for many years. While the name of the project may lack excitement—Reducing Duplication of Grants—thanks to some innovating thinking, and collaboration, and 10x’s validation of the project, the program turned out to be a big success.

U.S. Agency for International Development

The U.S. Agency for International Development’s (USAID) mission is to “lead the U.S. government’s international development and disaster assistance through partnerships and investments that save lives, reduce poverty, and strengthen democratic governance.” In doing so, USAID provides assistance to help partner countries become self-reliant and capable of leading their own development journeys. The agency operates in about 100 countries with a budget of about \$27 billion and a staff of over 4,000, making it one of the largest official aid agencies in the world—accounting for more than half of all U.S. foreign assistance.



Aubra Anthony serves as the strategy and research lead in the Center for Digital Development, which is located in USAID's Global Development Lab. Anthony leads a small team that carries out strategic research on emerging trends in digital technology. They investigate the social, political, and ethical dimensions accompanying the introduction of digital technologies in developing economies. Her portfolio has included: Machine Learning and Artificial Intelligence, The Data Revolution & the Global Partnership for Sustainable Development Data, Digital Identity, Open Data, and Ethnographic research on the use of data and information technology for decision making within USAID. Anthony has been with the agency since 2015.

As part of USAID's U.S. Global Development Lab, the Center for Digital Development (CDD) mission is to address gaps in digital access and affordability, and to advance the responsible use of technology and advanced data analysis in development.

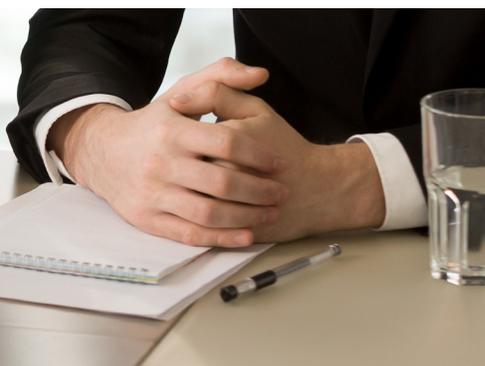
Anthony's team primarily conducts strategic research and provides advice on agency projects, rather than developing new technical applications. They identify global development challenges shared across different sectors regarding appropriate use of innovation in technology, and to learn and share best practices. Programmatic areas of focus across the agency include global health, food security, climate, resilience, democracy and governance, energy, education, economic growth.

Her team operates somewhat like a think tank within the agency. For example, they have conducted research on the use of artificial intelligence and machine learning in international development, programming with a focus on the numerous sectors that USAID covers.

She is most proud of the team's efforts to add the qualifier "responsible" in front of the term "innovation." Anthony's team does not simply push an innovation agenda for its own sake. Rather, they work to ensure responsibility in innovation. Whether turning to artificial intelligence, blockchain, or other kinds of machine learning, they constantly think about the appropriate use of those technologies in the context of developing countries. They identify approaches that can be sustainably integrated into a country's programmatic sector.

Through the years, the Center has developed a suite of technical training offerings, a series of toolkits and guidance documents, and a growing network of mission-based specialists. The Center cultivates a strong community of practice around Digital Development at USAID. Under the director's leadership, the Center works to foster market-led innovation and integrate digital technology, advanced data and geographic analysis, and digital development best practices into the strategic planning and design of enterprise-driven programs across the agency and with its international partners.

Anthony displays many of the characteristics shared by other interviewees in this report. She has a passion for solving problems and inspires those around her. She is both pragmatic and disciplined—yet most willing to experiment. And like others interviewed for



this report, she is a true collaborator less concerned as to who takes credit and more focused on fostering innovation. She most recently led the drafting of USAID's first-ever Digital Strategy, charting an agency-wide vision for development and humanitarian assistance through the use of digital technology in the world's rapidly evolving digital landscape.

U.S. Census Bureau

The U.S. Census Bureau has been headquartered in Suitland, Maryland, since 1942, and currently employs about 4,285 staff members. The Census Bureau is part of the U.S. Department of Commerce, and is overseen by the Economics and Statistics Administration (ESA) within the Department of Commerce.

Kate McCall-Kiley is a co-founder of the Census xD Program, an emerging technology lab within the US Census Bureau focused on infusing new technologies for the public benefit and institutionalizing experimentation along the way. McCall-Kiley serves as the group lead, and previously served as a White House Presidential Innovation Fellow. She was named to the 2019 class of MIT Media Lab Director's Fellows.



The Census Bureau is the home of the xD Lab. The xD Lab works with multidisciplinary teams of engineers, project managers, and data scientists to support the research and application of artificial intelligence solutions to the delivery of government services. Each team works with federal stakeholders across government and often with the support of outside partners, such as academic research groups, to apply the latest innovations in AI to each project. Current focus areas include AI-driven Data Augmentation, Ethics & Bias of AI, and Mis/Disinformation.

xD is unique in many ways. They operate with a small core staff yet have many partners within other federal agencies, and they occasionally turn to research universities and private enterprise when needed. A few projects funded by GSA's 10X program have provided them with funding across fiscal years; budget flexibility is at times essential for programs with longer timelines, and using 10X means that over time specific milestones must be reached to get to the next level of funding. Partnering with 10X also allows for quick termination of projects not meeting their objectives before more money could be wasted—thus saving taxpayers money.

Given its small size, McCall-Kiley and her group are very selective when bringing new staff into xD. They only hire people who are mission driven and appreciate the value of public service. McCall-Kiley remarked that xD curates the garden so wildflowers can grow—by cultivating the foundations all of the time, activities can deliver results all of the time.

Finally, xD also has a sound business model, with the objective of being self-supporting through outside funding and interdepartmental resource sharing.

State of Utah

Utah has a population of about 3.2 million and has one of the highest growth rates in the country. The Utah state government is known for its innovation and improvement efforts, dubbed “SUCCESS,” which is a framework and set of tools to help agencies better innovate and work collaboratively to solve complex challenges.



Mike Hussey has been Utah’s chief information officer for the past five years and is active in the National Association of State Chief Information Officers, where he currently serves its vice president as well as serving as co-chair of its National Innovation Forum.

Previously, he served as an IT manager and technologist at the University of Utah, and in the office of former Utah Governor Jon M. Huntsman, Jr., before being appointed Utah’s CIO in October 2015. Some of Hussey’s credits include helping to create the largest CD-ROM database network in the U.S., a central component of the University of Utah’s research efforts. Hussey also helped set up audio equipment to stream live sessions from the Utah State House and Senate online. In 2013, Hussey received the Governor’s Award for Excellence in Outstanding Public Service.

Hussey oversees Utah’s Artificial Intelligence (AI) Center of Excellence, an interagency group that meets monthly to generate ideas and provide funding for innovation. The Center promotes innovation and emerging technology in two important ways:

- First, the Center provides a forum for agencies to provide innovative ideas and educate the CIO about their challenges. The CIO does not know the possibilities, pain points, and challenges facing each agency, so this meeting gives Hussey and his team insight into the potential value-add that emerging technologies could have across the different state agencies. The session also serves as a central forum for agencies to bring ideas and collaborate with other agency leaders. Hussey noted that ideas that come forward in the monthly Center meetings see use across Utah’s state agencies.
- Second, the Center provides innovation seed funding to develop agencies ideas and provide momentum. So far in 2020, the Center has invested all the money in their innovation fund sponsoring ideas from agency technologists.

Many of the projects funded by the AI Center help Utah agencies partner with outside organizations on solutions. The Center also partners with the private sector to implement ideas. For example, by working with Amazon Echo’s voice recognition technology, they created an interactive practice driving test that can be taken by speaking into an Echo device. Citizens of Utah can also access hunting and fishing information from the state over their Echo device.

Hussey brings outside organizations into the AI Center of Excellence’s monthly agency meetings to suggest potential innovative application ideas within Utah’s agencies. For example, they discussed a project that was deployed by the State of Oklahoma that used a pizza delivery app with minor tweaks to help place foster children into nearby foster parent homes. The AI Center also funds partnerships with external organizations that propose ideas like these.

In addition, Hussey proactively works with the Utah legislature to gain support for legislative changes, such as making the state's procurement process more agile. This reinforces the Center's ability to succeed in identifying and supporting innovative solutions. By building a reputation of success, funding innovation across agencies, and building momentum to support emerging technology, Hussey and his team have helped the State of Utah to be seen as cutting edge among its peers.

Sonoma County, California

Sonoma County is the northwesternmost county in the nine-county San Francisco Bay Area region. Sonoma is the largest producer of California's wine country region and ranked as the 22nd largest county in the United States in agricultural production. Its population is approximately 494,336.

Sonoma County faced a growing need to provide more effective essential services to its highest need population, but like many local governments, the county's range of services are provided through multiple departments. Due to the siloed nature of the various systems involved, the county had limited ability to coordinate services among those departments on behalf of the citizens in need. Problems only became worse in the aftermath of the disastrous 2017 forest fires, after which the County Board of Supervisors made strengthening the social safety net a strategic priority. The Safety Net Collaborative formed the county's first interdepartmental multidisciplinary team (IMDT) consisting of members from the safety net departments working together with specific cohorts of high need homeless individuals to provide holistic services for those in need.

The fires highlighted the urgency to accelerate the planning process and move into an action process. This led to the creation of the award-winning Sonoma County Accessing Coordinated Care to Empower Self Sufficiency (ACCESS) Initiative. This program identifies the most vulnerable people in the community, and strives to help them through their personal journey to become more self-reliant. This includes individuals experiencing ongoing unemployment, homelessness or housing insecurity, behavioral health and substance use issues, and in the criminal justice system.



Carolyn Staats serves as director of Innovation, Information Systems Department for Sonoma County. Prior to coming to the county, she was a CIO in the private sector. Just prior to the forest fires in 2017, she began working with the Director of the Department of Health Services, forming a strategic bond of innovation and enabling technology to support the ACCESS initiative. This meant working closely with the Safety Net Collaborative to find a solution that would bring their disparate data into a centralized hub that could be accessed by the IMDT and specialists. As Staats studied the problems expressed by staff and citizens, she sought ways to tie all the loose ends together. She soon learned of a system that San Diego County developed over a six-year period.



San Diego's master data management tool was designed to deal with similar populations, so the data schemas and algorithms would need little modifications for use in Sonoma County. The County believed this solution could be used as a bridge of data elements drawn from numerous decentralized systems, and brought together into a central hub that could be viewed holistically by staff. Staats refers to the solution as "Lift and Shift."

One central tendency that has doomed many IT and data consolidation projects has been the feeling that "we are different" and need customization and conformance to local nuances and established norms. The innovation team was able to steer through the planning phases by letting everyone know that "when it comes to what's most important to know about a client's current state, we are the same." The issues faced by counties and cities across the state in helping the homeless population are not different. Once the team started putting the pieces together, they reached 91,000 unique clients across the first four systems in just four months.

Moreover, to gain access from various endpoints through a huge collection of data layers, they turned to a true cloud native solution that utilized a SaaS platform as the front-end for the data hub, with AI used to manage case notes. As a result, homeless service workers, social service workers, and health clinicians can see relevant information about a particular person as never before—and certainly never in one place.

And while Staats continues to be involved with ACCESS and expanding its capabilities, she recently completed another major and timely undertaking—a COVID-19 app that performs a wellness check for employees reporting to work. She was instrumental in working with an innovation team including the Public Health Officer to identify the key variables and focus on both functionality and privacy.

Sonoma recently launched the SoCo COVID-19 Check app that helps county employees and employers complete a wellness check to help prevent and mitigate the spread of the novel coronavirus. Each day, before starting work, employees complete a 15-second self-assessment for COVID-19 related symptoms and potential exposure to the virus. The employer portion of the app also takes approximately 15 seconds to complete, and asks employers to verify that employees do not have temperatures over 100 degrees and are wearing appropriate face coverings in accordance with the Health Orders of the County's Public Health Officer. Daily screening improves their ability to keep the community safe by reducing contact when symptoms are present. The app also includes a news feed that provides the latest information about COVID-19 from the County Department of Health Services, the State of California, and the Centers for Disease Control and Prevention. This includes infographics and up-to-date statistics for COVID-19 in Sonoma County. The app is streamlined and quick, relying on only a few simple survey questions to answer in seconds each day. The SoCo COVID-19 Check app does not increase privacy risk to its users as the app does not ask for name, address, or any other personally identifiable information.

Most remarkable was the fact that Staats was not a health care systems expert—but one would never know that in talking with her. She knows County systems and tools inside and out and from every perspective. And she has been able to listen, learn, apply, and test.

Innovation is about doing things differently and knowing the available tool sets and the many ways they can be applied. Sonoma Access continues to innovate, now expanding to include even more data sets and experimenting with using AI to seek trends that could be missed by traditional analytics, then drawing insights from the system to develop recommendations for improvement.



Keys To Success

While each case described above differs, some common themes and similarities emerge. First, innovation does not always rely on technology—it can begin with solving a problem or set of problems. Second, few innovations are created in a vacuum; instead innovators look at what was done before, and work to improve business processes for better outcomes. Third, brainstorming is contagious, and every example always involved more than one person; small or larger groups brainstormed an idea and arrived at an actionable outcome, made better by various inputs from colleagues and in some cases with industry support.

Of course, each of the leaders interviewed is a technologist, and all noted that today's toolbox includes an innovation suite where all the parts fit together when needed. Through lengthy interviews with these 13 innovators, five basic mindsets emerged:

- Entrepreneurial
- Collaborative
- Adaptive
- Mastery of emerging technologies
- Leadership

Understanding each of the five mindsets and their subparts points to the value of these keys to success towards how innovation and emerging tech can drive achievement goals for better government.



Entrepreneurial Mindset

Even in government one can have an entrepreneurial mindset, with satisfaction derived from achieving goals for the public good as opposed as someone's motivation to achieve fame or fortune. Those interviewed for this report demonstrated a strong desire to serve their customers, often including other agencies as well as the public. Each of the leaders interviewed are business minded and self-motivated, and took reward from the satisfaction of accomplishing something worthy and for the public good. Often observed qualities of an entrepreneurial mindset include:

- Adherence to and passion for public service
- Exemplify type A+ self-driven personalities
- Passion for helping the citizen/customer
- Ability to experiment without fear of failure
- Secure enough to leave egos at the door
- Self-motivated and driven by curiosity and problem-solving

While elements of the entrepreneurial mindset were present in each of the cases, the most demonstrable examples can be found in GSA's 10x program and the Census Bureau's xD program. Aside from GSA's traditional governmentwide role in managing real estate and vehicles, the agency has carved out numerous and sustained initiatives rooted in experimentation and coupled with a genuine desire to improve government service delivery to the public. In particular, GSA's 10x program was modeled on how entrepreneurs in the private sector operate—aiming is to seek creative solutions and applications from other agencies, but unlike typical federal funding schemes, minimizing risk of failure. The Census Bureau's xD program, while lacking direct funding, also operates in a similar fashion.



Collaborative Mindset

Each leader interviewed noted that any accomplishment represented the work of more than one and often many. These leaders were dynamic and keen on sharing ideas and concepts, and fearless in receiving feedback that might not always be positive. While each was proud of their accomplishments, they did not look to own success. Each individual was self-assured and always eager to share ideas and concepts. Other observed qualities of a collaborative mindset include:

- Building core groups and individual human networks of experts across complementary but different fields
- Artful in crossing traditional agency and department boundaries
- Willingness to share in success
- Excellent at managing expectations and building champions of support
- Exceptional at being part of and engaging multiple networks of innovators
- Cutting across traditional boundaries of thought and past practice

Each of the interviewees stressed numerous times that their accomplishments were the direct result of teamwork and brainstorming. In the case of Sonoma County, the local health director was instrumental in meeting with and lining up the support of all social

safety net managers—“silos of excellence” as she referred to them. The director then teamed up with the technology department, and together they could translate problems and challenges serving a highly vulnerable public. They jointly sought ways to improve the existing technology infrastructure to solve many challenges associated with providing comprehensive services to the intended audience. In this case it took a collaborative mindset to fuse the expertise of someone highly knowledgeable about the challenges facing the county in better serving a vulnerable population with that of the chief innovation officer—who until a first meeting had no expertise in health or social services.



Adaptive Mindset

Each individual displayed an innovative mindset, demonstrated by their desire not to get comfortable always doing the same things in the same way. They viewed themselves as objective thinkers and strategists, with a solid grasp of the current state as well as the ability to contemplate improvements by doing things differently. As importantly, they did not fear thinking of projects with far-reaching and possible high-risk outcomes. Other observed qualities of an adaptive mindset:

- Willingness to experiment and adapt based on results, intended and unintended
- Strong focus on emerging technologies and how they are being adapted
- Motivated by trying to improve business processes that positively impact the citizen/customer experience
- Innovation is a creative process that has more to do with people and governance, than technology itself

Adaptation rarely occurs in a vacuum. It can be brought on by a crisis (think pandemic), severe budget cuts, or from someone or group who have taken the time to step back and say, “Should we simply repave the cow-paths of the past—or should we be thinking of designing new roads?” But an adaptive mindset can also occur in a culture that strives for continuous improvement. For example, NOAA—perhaps because it is a scientific body made up of science-seeking individuals—always seeks new answers to old questions and looks for ways to improve both process and substance. The Department of Veterans Affairs provides another example of the adaptive mindset, especially VA’s early use of chatbots to help veterans through providing a highly useful app to better connect veterans with their needs.



Mastery of Emerging Technology Mindset

While not all innovation has roots in technology, all the interviewees did have roots in technology and can grasp which technologies might best address a given challenge. Each individual tracks the latest technologies and applications, and comprehends the interrelationships of how emerging technologies work together as a system or suite of offerings. Other observed qualities of a mastery of the use of technology tools and an emerging technologies mindset include:

- Confidence in the program’s approach and direction
- Grounded appreciation on the limits of technology
- Deep understanding of the problem to be solved matched with the appropriate solution

- Fearless in seeking answers to technology challenges
- Ability to change course when unsurmountable roadblocks appear

As stated earlier, innovation need not be tied to technology. Yet, technology is tied to innovation. Today's public manager needs to be aware of how emerging technology can help solve current challenges while also seeking proactive solutions to future challenges. This begins with a deep understanding of a challenge, and then turning to a "master mechanic" who understands which technologies works best and under what circumstances and conditions.

Technology—even emerging technology—is but a set of tools. The emerging technologies discussed in this special report demonstrate that the tools can be highly interrelated as part of an "innovation suite." For example, AI and blockchain receive significant attention, yet both depend on data management and data analytics.

The mastery of technology involves the mastery of the various tools. Yet most of those interviewed did not have technical backgrounds, instead having degrees including business, economics, or accounting. While not everyone can be or should be expected to be a master of emerging technology, innovators should be able to hire and reach out to masters who can collaborate effectively with agency teams and stakeholders.



Leadership Mindset

Each of the interviewees held a high level of authority regardless of staff size. They exuded self-assurance and yet they were also exceptionally modest. They all tend to have leadership qualities that inspire, and have a track record of to earn the respect of both their senior leadership and the teams who report to them. Other observed qualities of a leadership mindset include:

- Self-confidence and inspiring to others
- Knows when to pull back and let others take charge
- Places their ego at the entrance door
- Encourages reasonable risk taking
- Makes it clear they are open to new ideas and approaches
- Leads by example
- Sets high, ethical, and honest standards

The leadership mindset was strongly demonstrated in each interview—like the glue that binds together all the moving pieces of people, process, and technology. In every case, the leader encouraged a collaborative environment conducive to experimentation without immediate fear of failure. Each of the innovators described in this special report are highly self-motivated and self-assured and inspire staff to think differently. They all displayed humility and a high level of emotional intelligence.

Leadership has always involved motivating others to do things they might not do on their own. Innovation and emerging technology will always point to new horizons, Leadership is a critical element in creating the right environment, incentivizing the right staff, and providing the necessary resources.



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