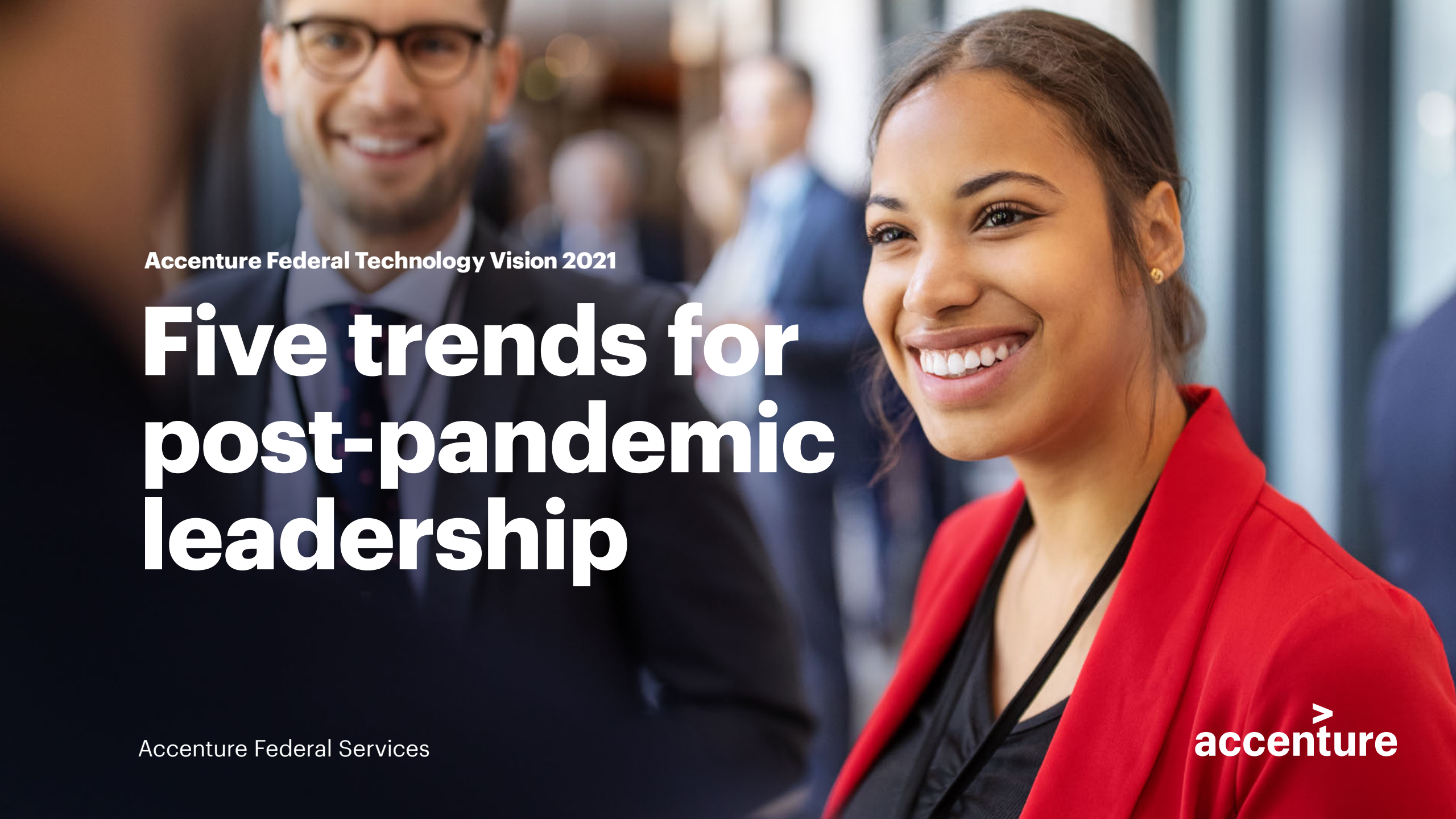

Accenture Federal Technology Vision 2021

Five trends for post-pandemic leadership

Accenture Federal Services

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Contents

The challenge ahead for federal leaders: Becoming masters of change at a moment of truth

Federal agencies gained a new understanding of what they're capable of during the pandemic. Now they need to carry those lessons forward.

If federal agency leaders learned anything last year when the COVID-19 pandemic turned the world on its ear, it was this: Technology is vital to the mission.

Of course, many understood this before 2020, as they witnessed cloud computing, artificial intelligence, automation, and other advancements rapidly re-modeling the world around us. But the almost overnight transformation that we all experienced in the spring of 2020 brought home just how integral technology is to our lives, our businesses, our ability to get things done, and our ability to be resilient in the face of crises.

As Dana Deasy, Defense Department CIO, told reporters in April 2020, "We are truly in unprecedented times in our nation. The national emergency due to the coronavirus, COVID-19, global pandemic has no doubt brought new changes to the ways Americans go about their daily jobs. Specifically, the way we work has changed dramatically within the last month."[1]

No wonder, then, that swift and sweeping technology modernization initiatives took center stage as the federal government adopted a wartime footing in response to the pandemic. By late April 2020, federal agencies had spent $1.1 billion on IT goods and services to address challenges brought on by COVID-19, according to one analysis.[2] Priorities were hardware and network modernization to support newly remote workforces, cloud services, tele-health capabilities, data management and analytics, cybersecurity, and other needs.

The Small Business Administration, for example, spent $393 million on IT in March and April, much of it on data analysis services needed to help make loan determinations as part of the CARES Act small business relief program.[3] But it wasn't just SBA that had an immediate need to quickly interpret and analyze what was going on to meet its mission: COVID-19 touched off a 40 percent spike in big data spending across the entire government from 2019 to 2020.[4] The Veterans Affairs Department, for example, invested in a Palantir Gotham subscription to track and analyze COVID-19 outbreak areas, supply chain capacity, hospital inventory, social service utilization and lab diagnostics. The Health and Human Services Department and the National Institutes of Health needed COVID-19 data storage and backup storage. And the Treasury Department required tools for procurement reporting and to track COVID-19 spending.[5]

57% of federal executives report the pace of digital transformation for their organization is accelerating.

97% of federal executives report the COVID-19 pandemic created an unprecedented stress test for their organizations, ranking the greatest stress test to their organization as:

1. Their technology architecture
2. Their strategy
3. Workforce
4. Processes

Government leaders also proved that, with technology, federal agencies *can* undertake big change rapidly when they need to. In short order, federal agencies got most of their employees working remotely and installed IT infrastructures to support that. The Defense Department, for example, rolled out secured network capacity and cloud-accessible work environments to roughly 4 million military and civilian personnel around the world within weeks. This included the deployment of a DoD-version of Microsoft Teams and other Office 365 tools, dubbed the Commercial Virtual Remote (CVR) environment, thereby making chat, video, and document collaboration available on personal and mobile devices. In a single day in early April, the department activated more than 250,000 CVR accounts, DoD's Deasy said, adding, "This is the largest rollout ever implemented in this short amount of time."[6]

"We're at war. It's a different type of war, but it's war nonetheless," said Air Force Lt. Gen. Bradford Shwedo, CIO of the Joint Staff. "To give you a sense of the urgency, the previous pace [for rolling out remote work collaboration tools and virtual private networks] was once two years from planning to implementation—now, these upgrades are happening and completing in days to weeks."[7]

Even as they were transitioning to remote operations, federal agencies had to simultaneously manage the unfolding crisis and execute their day-to-day missions. Congress at this time had passed trillions of dollars in COVID relief assistance, of which federal agencies received more than $82 billion for program administration and oversight.[8] And they had to spend this extraordinary amount of funds quickly and smartly to save lives and stem economic hemorrhaging. The Department of Veterans Affairs, for example, increased the number of telehealth video appointments using its VA Video Connect service from roughly 10,000 appointments a week in February 2020 to 120,000 three months later due to COVID-19.[9]

91% of federal executives report that their organization is innovating with an urgency and call to action this year.

In short, federal agencies across government accomplished things during the pandemic emergency that many federal leaders previously would have said were impossible. Now we know that things once viewed as impossible are indeed possible. Through the challenging crucible of this pandemic, federal agencies have emerged with a new mindset about themselves. They have shown to themselves and the nation that they can adjust quickly to challenging circumstances, work differently when they need to, and bring technology to bear to solve big challenges quickly.

The question now becomes: How pervasive and impactful will this shift in mindset be? Today, federal government leaders have a golden opportunity to harness this mindset shift and declare that this is how we will operate in the future. This will be critical because the rate of change that's been accelerating these past two decades and that hit a fever pitch during the pandemic shows no sign of letting up, even as we prepare for a post-COVID world.

92% of federal executives believe capturing tomorrow's market will require their organization to define it.

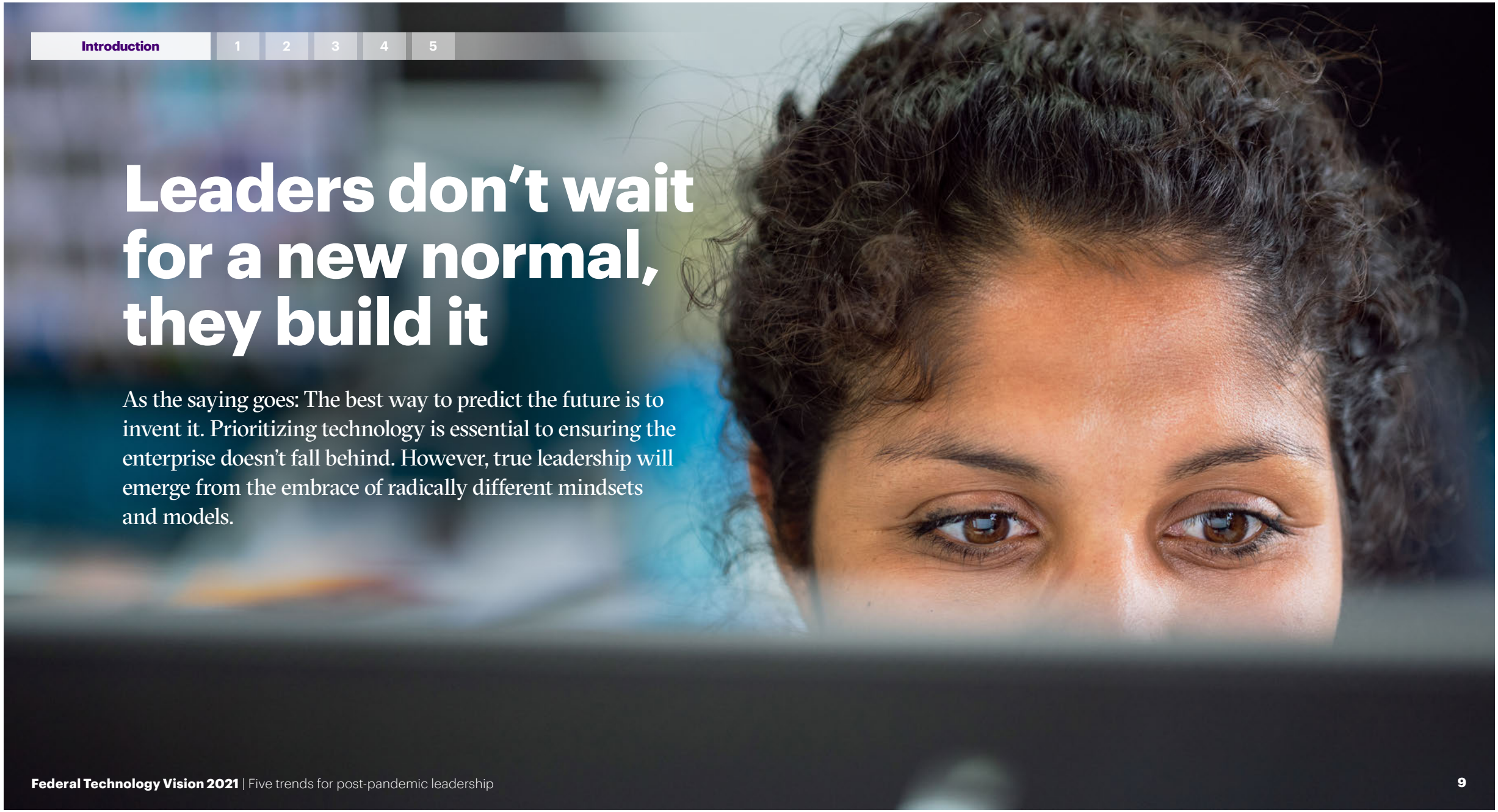
Leadership demands technology leadership

To carry the lessons of 2020 forward, federal agencies need to drum the word impossible out of their vocabularies and work together to solve big challenges. They must take the lessons of the past year to heart and hardwire their organizations and mindsets to be ready and adaptable for continuous change and resilient to whatever comes their way. This requires federal agencies to build the right innovation environments and cultures and remove remaining organizational barriers that divide technology from the mission so they are both moving forward as one.

This is a challenge that demands a new kind of leadership.

Agency leaders can no longer afford to be merely business or mission leaders—they must also be technology leaders, fully versed on how technology intersects with and advances their mission ambitions. A digital-first approach must be fostered by the entire C-suite and manifested across all areas of the organization. This is how agencies can pivot from being reactive to proactive to predictive, how they can thrive in an era of unprecedented variability and complexity, and how they can remove blind spots as they chart a bold course ahead.

The challenge ahead also requires that leaders do better at leveraging the resources around them: employees, stakeholders, industry partners, vendors, and other agencies. To innovate, organizations need to expand the diversity of thought and experience they expose themselves to—that's the only way to expand one's vision of what's possible.



Leaders don't wait for a new normal, they build it

As the saying goes: The best way to predict the future is to invent it. Prioritizing technology is essential to ensuring the enterprise doesn't fall behind. However, true leadership will emerge from the embrace of radically different mindsets and models.

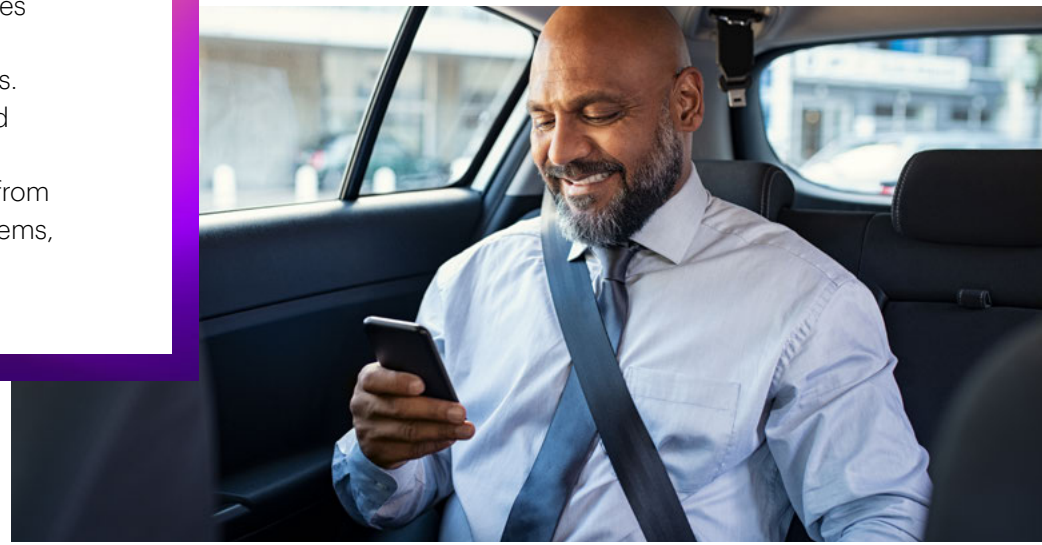
The world has been beset by sweeping change and demands leadership that thinks boldly in response.

Thriving in this moment will require ambitious leaders not content to rehabilitate what was, but who are willing to upend convention and wield their vision for the future. Leaders have spent decades building systems—workforces, supply chains, technology infrastructures, operating and business models—that were suitable for an era when change happened slowly and expectedly. But today, success will come to those with the audacity to reimagine it all.

In the last year, enterprises were forced to confront deep-seated assumptions about how fast the organization can pivot, and where or how work gets done. Before the pandemic, if you asked Defense Department executives how long it would take to deploy a new office collaboration platform across the department, few if any would have said it would be possible in less than a year. But we found out that with the right level of priority and leadership, anything is possible.

This journey of reinvention has only just begun. The pandemic radically accelerated changes that agencies knew were coming but didn't expect to see so soon. While it will be tempting for agencies to retreat to what they know, 2020 brought the need for a different path forward into clear focus. If federal agencies continue to have a clear-eyed perspective and sharp focus on their expedited digital transformations, reimagining everything from their people, to data, architectures, and ecosystems, they can emerge as leaders.

We found out that with the right level of priority and leadership, anything is possible. This journey of reinvention has only just begun.



The technology trends shaping federal agencies in 2021 and beyond

In our Federal Technology Vision 2021 report, we see how many federal agencies are beginning to imagine and build their digital future.

They understand the importance of architecting for the future and recognizing that business and technology strategies are increasingly indistinguishable. Architecture has never mattered more—and the options available have never been so vast. But getting this piece right is critical, as the technology choices that agencies make today will determine their possibilities and constraints far into the future.

As leaders thread technology through all aspects of the business, the valuable troves of data generated are being used to build massive networks of intelligent digital twins. This *mirrored world* that these next-generation twins create is fueling change by unlocking the value of data and allowing enterprises to simulate, predict, and automate by seamlessly bridging the divide between digital and physical.

Government enterprises must also ensure their people are empowered to become drivers of change—an outcome achievable through technology democratization, which is making powerful technology capabilities accessible without the need for specialized skills. Many agencies are already igniting grassroots innovation by equipping all employees with the tools and skills to build technology solutions at the point of need.

And, as we've all seen, agencies are also redefining the workplace of today and tomorrow. The pandemic forced agencies to quickly shift from a "bring your own device" accommodation for their employees to a "bring your environment" approach in which employees are working from anywhere and everywhere. The single biggest workforce shift in living memory is positioning federal agencies to explore the benefits of a virtualized workforce and expand the boundaries of the enterprise.

Finally, the challenges and opportunities ahead are vast and agencies will not be able to tackle them alone. Multiparty systems—operating on the foundation of a shared digital ecosystem enabled by technologies such as blockchain—provide agencies entirely new models for how to address complex challenges that affect many stakeholders. From supply chains to digital ecosystems, the pandemic showed just how brittle globe-spanning relationships can be. By rebuilding these partnerships with technology at the center, enterprises are finding ways to adapt together.

A new future is on the horizon—one that's different from what the world expected. As this future takes shape, there will be no room for enterprises that cling to the past. Will you watch the world change around you? Or be the one leading it? People are ready for something new and it's time for enterprises to join them. Let there be change.

> Will you watch the world change around you? Or be the one leading it?

Trends overview

The Federal Technology Vision identifies five key trends that federal agencies must address to capitalize on this moment of truth over the next three years to lead in the post-pandemic world:

Stack Strategically

Rearchitecting government for what's next

A new era of government is dawning—one in which an agency's technology architecture will be a critical factor in whether they succeed or fail in their mission responsibilities. But building and wielding the best technology stack for mission success means thinking about technology differently, and making business and technology strategies indistinguishable.

Mirrored World

Digital twins report for duty

Leaders are building intelligent digital twins to create living models of shipyards, jet fighters, supply chains, product lifecycles, and more. Bringing together data and intelligence to represent the physical world in a digital space will unlock new opportunities to operate, collaborate, and innovate.

I, Technologist

Empowering innovators in the workforce

Powerful capabilities are now available to people across the agency enterprise, adding a grassroots layer to enterprises' innovation strategies. Now every employee can be an innovator, optimizing their work, fixing pain points, and keeping the business in lockstep with new and changing needs.

Anywhere, Everywhere

Integrating your virtual workplace

It's time to transform remote work from an accommodation to an advantage by rethinking what the organization looks like and what it can achieve with a virtualized workforce model. Leaders must develop "bring your own environment" strategies, addressing the security ramifications of remote work, necessary cultural shifts, and the evolving purpose of physical office space.

From Me to We

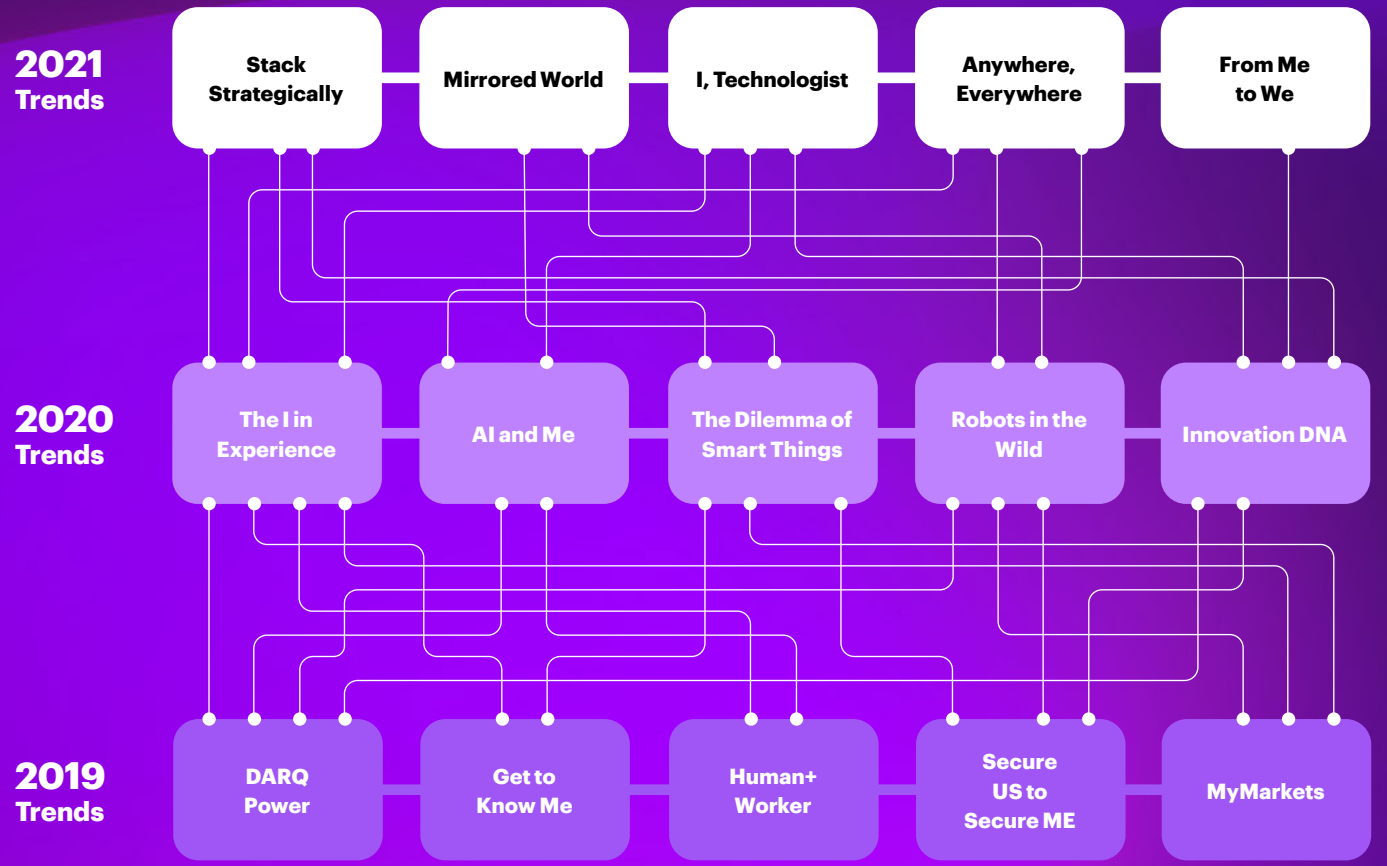
Take the mission further with multiparty systems

The demand for contact tracing, frictionless payments, and new ways of building trust brought into sharp focus what had been left undone with enterprises' existing ecosystems. Multiparty systems enable agencies to employ the power of partnerships and trusted data to address increasingly complex challenges.

Completing the picture

Accenture's Technology Vision report comprises a three-year set of technology trends, currently including trends from 2020 and 2019.

It's important to recognize that each year's trends are part of a bigger picture. Tracking how they evolve over time offers a glimpse into how they may continue to grow in the future.



Why *Federal Technology Vision*

Technology is advancing so rapidly, it's hard to keep up—even for IT leaders!

But increasingly, we live in a world where every organizational leader needs to be a technologist because technology is driving the rapid transformations we see occurring all around us. Technology is so integral to mission success today that federal agency leaders no longer have the luxury to leave the technology to the IT folks. They need to spend time and energy understanding what technology is here, what's coming around the corner, and what the impacts are.

The problem is that there is a lot of noise out there about technology, and it's really hard to know where to focus. The Accenture Federal Technology Vision is our attempt to help federal leaders separate the noise from the signal by providing extensive research and real-world examples of what's happening globally as well as within the federal sector around today's technologies.

The Accenture Federal Technology Vision is not about technology—it's about offering insights into what government and commercial leaders are doing in response to the major tech trends of the day and how are they leveraging technology to make their enterprises smarter, more agile and resilient, and more effective in addressing today's complicated business and mission challenges.

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Trend 1

Stack Strategically:

Rearchitecting government for what's next

A new era is dawning for today's federal enterprises—one where the strengths and capabilities of their technology architectures define more than ever how they execute their mission. To succeed, agencies will need to think about technology differently, making their business and technology strategies inseparable if not indistinguishable. In short, the agency's technology architects can no longer be supporting cast—increasingly, they are feature performers from a strategic perspective.

Enterprise success and failure increasingly hinges on technology architectures

Amazon's business strategy uses low costs, vast selection and fast delivery as an often-unbeatable competitive differentiator. The company had long invested in a technology architecture to deliver upon this value proposition. When the COVID-19 pandemic shifted the nation to online shopping in an unprecedented way, the company was able to continue to scale its business to meet skyrocketing demand with the world's largest retailer growing an incredible 37 percent and adding over 250,000 employees in 2020.[10]

Amazon's success underscores the extent in which technological capabilities can both define and embody an organization's strategy. It also reinforces the value of enterprise agility achieved through digital transformation. In contrast, some state governments were forced to call for volunteers with COBOL programming skills to help update their unemployment systems to meet a surge in applications.[11]

While enterprises anticipated this shift to digital, many of them miscalculated the speed in which it would arrive. As a result, few actually approached their technology and business strategies as one. Now, that's all changing. In response to the COVID-19 pandemic, companies and government agencies alike made rapid digital transformations, accelerating their journeys to the future.

But as enterprises modernize at pace, they are realizing all too well that technology is no longer one-size-fits-all—there are far more commercially available technology options than ever before and the choices they make today can radically alter their value propositions for tomorrow. From the distribution of cloud deployments, types of AI models, and wide range of edge devices, to the design, or even basic physics, of hardware and computation—each layer of the stack is expanding into new dimensions. The abundance of "as a service" solutions, improvements in technology standards, and the proliferation of growing cloud foundations taking root across government make it possible for agencies to design and assemble stacks of technological capability customized to their unique mission and business needs.

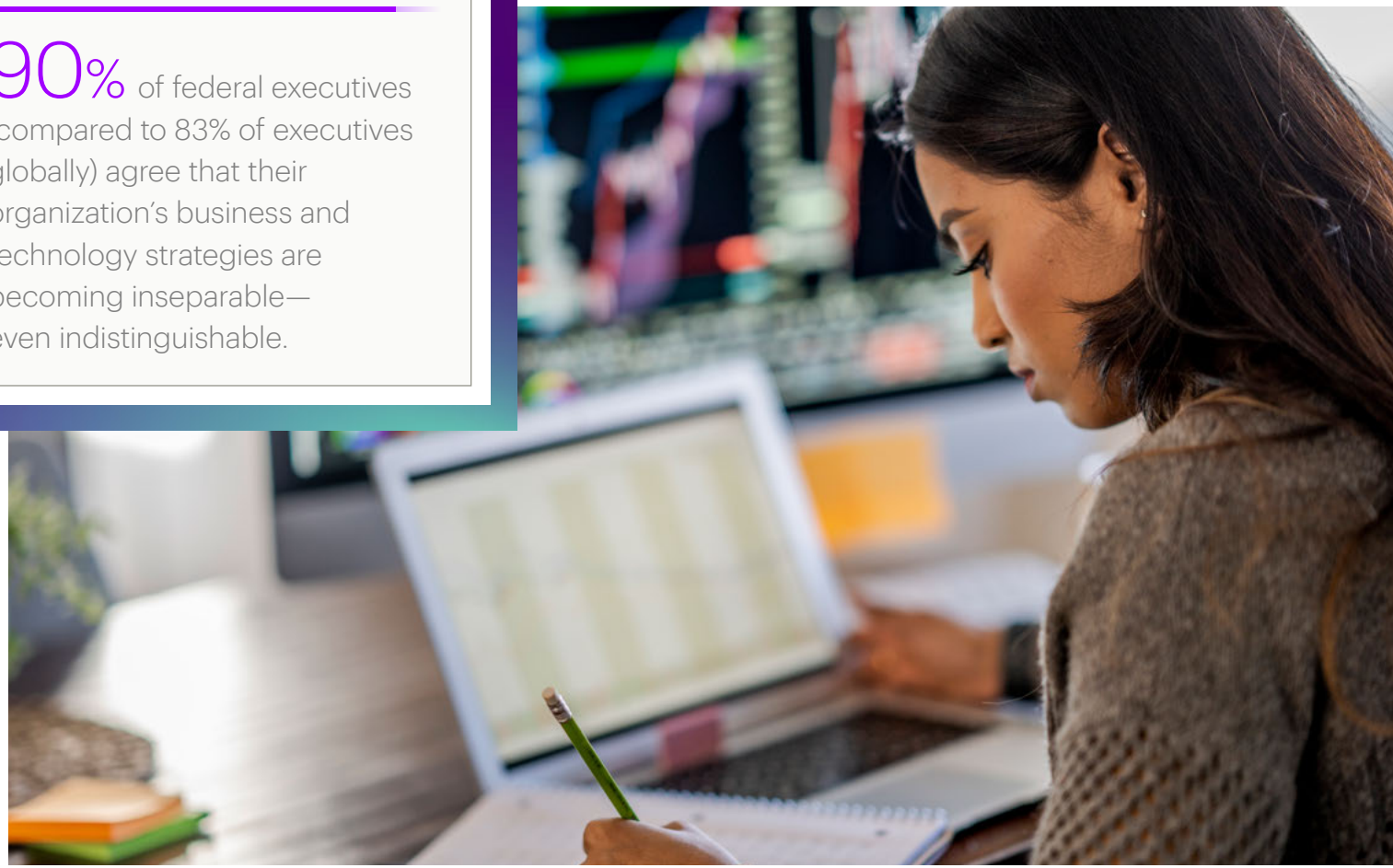
This range of options presents both opportunity and risk. The opportunity for government agencies is to tailor and optimize every layer of their technology architectures for mission success. The challenge is that many federal organizations remain encumbered by outdated infrastructures and are struggling to recalibrate their strategies and architectures to take advantage of this abundance of choice.

Government and commercial enterprises are now at a critical decision point. To achieve their mission and competitive ambitions over the long term, they must start designing and optimizing their technology stacks in a way that they can harness data and emerging technologies to become smarter, more resilient, more responsive, more efficient, and more capable in their day-to-day operations. As they make investments in cloud, data analytics, and emerging technologies, they will need to think about the long-term impact these choices may have—either limiting or propelling them in the future.

While the challenge of stacking strategically may fall to the CIO and other IT leaders in the agency, it is critical that mission and business leaders play an active role as well. They must educate themselves about emerging technologies and how they can propel the agency's mission and business operations so they can actively collaborate with IT leaders in making key architectural decisions. But they also must understand the strengths and constraints of their current architectures so they can leverage those capabilities effectively.

In this era where architecture matters more than ever, leaders will be decided not just on the success of their mission and business plans but by the ingenuity of their technology choices.

90% of federal executives (compared to 83% of executives globally) agree that their organization's business and technology strategies are becoming inseparable—even indistinguishable.



The federal imperative to stack strategically

The government's mission needs change constantly. And as technology advances and information swells and accelerates, those mission needs adjust and grow more complex at an increasing pace. Congress regularly passes laws that change or create government programs. Industries continue evolving in their practices and technologies, requiring oversight agencies to keep pace. Complex national crises emerge and morph, forcing agencies to pivot quickly. To adjust successfully to these challenges, agencies require rapid, tailored, technology-enabled responses.

The problem is that many agencies today lack infrastructures that are sufficiently robust and versatile to meet the challenge. Their IT environments impede the rapid transfer and processing of data wherever it might be needed and the easy insertion of new technologies.

Agencies find themselves unable to quickly deploy new applications or adjust existing ones or scale them to accommodate expanding needs. Many struggle at incorporating automation and incubating emerging technologies like machine learning (ML) and artificial intelligence (AI) to make their operations faster, smarter, and less expensive.

These challenges bring the concept of *technical debt* to the forefront. Technical debt refers to the constraints created by deferred technology modernization. This leaves many federal organizations working *around* their IT infrastructures to accomplish mission objectives. Instead, federal agencies need to build *technical wealth* where it becomes an asset by establishing a clear path to move away from static, unadaptable legacy systems and towards living systems that continuously evolve and adapt to changing requirements.

Only 30% of federal executives say that technology drives their organization's overall strategy and goals.

Viewing architecture as strategy

So what does stacking strategically mean in this context? First, it means ensuring that the agency is thinking strategically about technology and data and that it has developed a clear sense of how to weave technology and data into its organizational DNA. This is where the military finds itself today with the development of its Joint All-Domain Command and Control (JADC2) concept.[12] And across government, this process must include educating mission and business leaders to the strengths and constraints of the current architecture, including the possibilities and opportunities inherent in it.

All of this may require that we reimagine the role of the enterprise architect (EA) to start. Historically, the EA was entrusted with ensuring technology investments supported the mission and were sustainable. The challenge is that they often lacked real-world authority to implement their enterprise-wide vision. Without an effective EA program, agencies can find themselves mired in technology sprawl—with an incongruous aggregation of disparate, domain-centric infrastructures—that slows or even conflicts with the agency's broader technology ambitions.

Today's EA needs to adapt more readily to the demands of "living systems" that are continuously evolving with added functionality and managed as "products" with defined lifecycles. These systems will increasingly rely on self-learning AI and distributed edge computing operating across a highly-fluid multi-cloud environment with hundreds or thousands of third-party managed services and platforms. With all of this occurring, there is a growing need for a single function within the enterprise to manage that complexity and ensure it is aligned with and serves the agency's larger goals.

> 87% of federal executives believe that their organization's ability to generate business value will increasingly be based on the limitations and opportunities of their technology architecture.

There are challenges aplenty (but don't let those stop you!)

Everyone knows it's hard to upgrade an airplane while it's flying. So how do agencies start stacking strategically when they already have expansive, heterogeneous IT environments in place, comprised of both modern and legacy systems, that are critical to the agency's operations? And how do they transition from a position of technical debt to one of technical wealth?

The U.S. Department of Education's Office of Federal Student Aid (FSA) overcame these challenges when it modernized a mission-critical suite of applications that process federal financial aid for those seeking postsecondary educations. These efforts reflect FSA's commitment to benchmark itself against leading commercial financial service providers. It realized that only by decoupling its applications from a mainframe environment and moving to a more modern architecture could it deliver a more consistent user experience across multiple channels and employ emerging technologies, such as AI-enabled chat bots, for improved customer service.

To achieve this vision, FSA re-architected a suite of mainframe-based applications—collectively known as the Common Origination and Disbursement (COD) system—to a fully automated, modern technology stack hosted on a FedRAMP-authorized cloud service provider, AWS GovCloud.[13]

The results speak for themselves. COD applications more than doubled from 40 to more than 80, and test environments grew ten-fold, from four to more than 40—all due to the use of automation, containerization, and a flexible cloud architecture. To accommodate frequent architecture and application changes arising from new legislative requirements or business-driven enhancements, a fully automated DevSecOps platform supports continuous integration/continuous deployment (CI/CD) pipelines with new deployments occurring weekly during peak change periods.

Enabled by the DevSecOps model and an everything as code approach, the system architecture expanded to support new programs after the initial cloud transition. These focused on new patterns based on microservices with an API first approach for development. These scaled to include over 50 microservices providing data services for front ends to support borrowers and schools within the student loan process.

Transitioning COD from mainframe to cloud not only renovated the application's technology stack, it also drove the retooling and growth of its architecture, operations, and security teams. And this success has encouraged FSA to transition other core systems to the cloud as well—by the end of 2021, 60 percent of FSA's enterprise systems are expected to be running in the cloud.

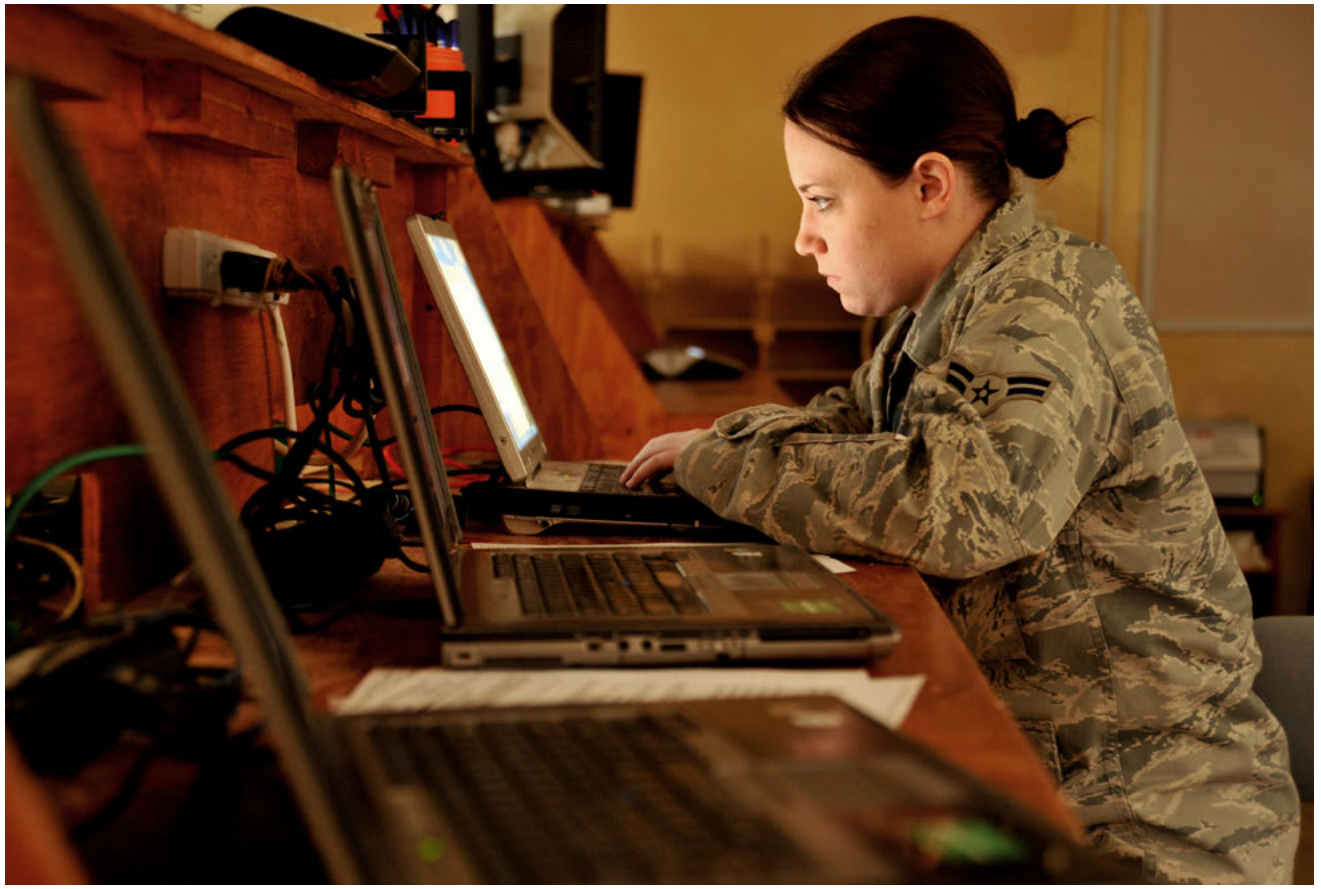
> **74%** of federal executives say their technology architecture is becoming critical to the overall success of their organization.

Explore further

Fortify:

Creating technical wealth

It is possible to reduce technical debt *and* build technical wealth at the same time, as FSA's example shows us. Specifically, a strategic approach towards digital decoupling—in which legacy systems evolve towards a modern architecture at a sustainable pace for the agency—can generate the cost-savings needed to help fund modernization.[14] This thinking is what spurred the creation of the federal government's Technology Modernization Fund.



The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

But another key take-away from the FSA example is that it is not enough to simply migrate applications to the cloud. When agencies "lift and shift" applications en masse to the cloud without also re-imagining the intended outcomes and the applications themselves to take advantage of the modern tools and capabilities the cloud offers, they are missing out on a huge opportunity that can have carry-over effects benefiting other applications and projects.

The emergence of these cloud-native architectures is poised to create a world of haves and have-nots across the enterprise landscape. Those that have embraced microservices, containerized, and serverless architectures to create more modular, plug-and-play applications can now innovate and adapt at digital speed. For example, the U.S. Department of Agriculture (USDA) is a collection of 29 agencies with nearly 100,000 employees. To create a more integrated, insight-led agency operating under one version of the truth, USDA implemented an API architecture using Mulesoft's integration platform that allowed it to consolidate operations within eight mission areas, maximize technology ROI through decoupling and reuse, and provide more integrated customer service.[15]

Just as with applications, agencies should likewise view their data as a huge opportunity to create technical wealth. This requires looking at your data assets through a broad lens and reimagining other potential consumers and purposes for that data. For example, how might your data assets add value when correlated with other data sets? What about making data more available to queries from agency stakeholders and other third parties or from a wider base of consumers within the agency or across agencies? Could connecting disparate datasets via APIs add greater functionality to existing applications? How will incorporating AI or ML layers into your data processing help position certain mission operations on a more proactive or even predictive footing. These are the questions that leaders should be asking.

The military services are reimagining their use of data. "The power in the data connected is something that Army senior leaders need," said Lori Mongold, chief of strategic operations enterprise in the Army Management Office.[16] To that end, the Army imposed a governance structure to promote more data sharing. It created an Army analytics board, an Army data board, and mission-area data officers focused on how to better leverage data to advance major mission categories such as the Business Mission, Warfighter Mission, Defense Intelligence Mission, and Enterprise Mission. Through these efforts, Mongold notes, "I see the gap closing between our ability to have a seamless data exchange and a seamless approach to the Army's ability to make more sound, risk-informed decisions, and defeat our adversary in a domain where we probably have lacked our ability to do that."

Another important point here is that stacking strategically can be done one step at a time. Don't try to boil the ocean. Establish an architecture, implement it incrementally, be agile throughout, and drive mission value while you're doing it, keeping a living systems mentality. In this way, you can deliver mission value very quickly. When you do migrate to the cloud, use an architectural approach instead of moving data or an application as-is and then re-architecting it later.

Extend:

Adding mission value through technology

With a technology foundation built for change, enterprises will unlock the true value of aligning technology and business strategies—tapping into today's wide range of technology options. The extraordinary array of technology capabilities emerging today is yielding far greater variety in business tactics and solutions. Enterprises no longer need to approach problems in the same ways everybody else does, and their unique technology solutions will be their edge in advancing mission success.

So how can agencies position technology to have a bigger impact on the mission from a strategic perspective? As we saw from the FSA example, one of the best ways to do this is by connecting the mission clients within the agency to the cloud. Increasingly, the real power of the cloud is no longer rooted in elasticity alone—it's also in the rich variety of tools that cloud service providers (CSPs) offer to develop and deliver innovative services. Most CSPs approved for government use, including AWS, Google, Oracle, and Microsoft, offer robust suites of tools and automated processes for developing, testing, securing, and deploying microservices and containerized applications.

In taking this approach, more and more agencies—such as the Homeland Security Department, the Treasury Department, and the CIA—are embracing multiple CSPs.[17] This multi-cloud approach has numerous benefits, such as creating greater parity; the opportunity to tap into multiple, best-of-breed platforms and applications; a lower reliance upon a single vendor; and limiting an agency's exposure to costly bid protests. But there may also be downsides, such as higher cost, the need for broader workforce skillsets, and proprietary barriers when performing operations across different CSPs.

It's important to point out that making the cloud—or even multi-clouds—available across an organization may not be sufficient. The client organizations charged with executing the agency's missions may not know what to do with all that capability.

This is where organizational adjustments can be helpful. For example, agencies should ensure their IT leadership—including the CIO, the CTO, the chief data officer, and the enterprise architect—are in alignment on the enterprise IT strategy and the need to build technical wealth across the enterprise. Also, empowering the enterprise architect within the agency and positioning it as a true adviser to the mission owners can help expose mission program teams to the art of the possible: How can edge computing dramatically transform the way agency operations are done today? What value can distributed ledger technology bring to the agency's financial operations? And how can AI and ML save our agency millions of dollars in maintenance and logistics costs or remove our case backlogs?

These are the types of questions and conversations that can be occurring when the EA is aligned more tightly with the mission side of the agency. An empowered, centralized EA function also would help ensure the agency benefits from operational synergies through the sharing of tools, data, managed services, resources, security, and applications.

> Increasingly, the real power of the cloud is no longer rooted in elasticity alone—it's also in the rich variety of tools that cloud service providers (CSPs) offer to develop and deliver innovative services.

Considerations when re-architecting

Enterprises increasingly will be moving toward multi-cloud environments, so agencies will need to architect accordingly. For example, if an agency has multiple cloud vendors, it will need to think carefully about where it stores its data and where it processes that data because it may be impractical to store a large dataset in one CSP and process that same data in another CSP. These considerations revolve around the concept of *data gravity*. Data doubles roughly every two or three years—at this growth rate, data quickly becomes immovable in a practical sense, requiring compute and processing capabilities to be proximate to the data. This emphasizes the growing need for edge computing in the future—and architectures will need to accommodate that shift. In fact, around 10 percent of enterprise-generated data is created and processed outside a traditional centralized data center or cloud, according to Gartner. By 2025, Gartner predicts this figure will reach 75 percent, in part because of the proliferation of maturing IoT solutions and 5G connectivity.[18] The lesson here is that, too often, agencies place a lot of focus on their applications architecture and migrating their apps to the cloud and not enough focus on their data architectures—and that oversight could leave them in a bind.

The U.S. Postal Service exemplifies this trend. The agency was already using AI for address resolution within its mail handling system. However, processing 230 packages every second across nearly two hundred distribution centers created latency constraints for more complex analysis of the 20 TB of imagery generated daily. By implementing a Nvidia-based computer vision system at the periphery of the network, the Postal Service could capitalize on existing imagery to locate lost packages. Estimates suggest that this new system can accomplish in twenty minutes calculations that previously would have required two weeks to complete, reducing the time required to locate lost packages from days to hours.[19]

Another trend shaping the way IT architectures are evolving is the changing nature of hybrid cloud, which is also driven largely by the data gravity problem. Traditionally, hybrid clouds have been thought of as cloud extensions of an on-premises data center. But because of the increasing need to bring processing power to the edge where much of the data is being generated, cloud service providers are offering clients the ability to extend cloud services to on-premises locations at the edge. AWS Outposts, Azure Stack Hub, and Google Anthos are examples of this.

In general, data is becoming an ever-larger concern for enterprise architects. They must work with their CDOs to develop a solid understanding of the data they are responsible for—where it resides, where it needs to go for processing, and the costs of egressing that data, if necessary—as well as the network bandwidth and latency considerations around that data transmission and then find efficient solutions to those challenges.

Reinvent:

A new generation of technology and business

One of the big payoffs from digital decoupling is creating distinct services that can be reused across multiple applications. In doing so, this functionality shifts from working within a known environment and context to operating more autonomously with less visibility into how it is being used. This means that we often need to take more proactive steps to ensure appropriate use, as what was once understood must now be made explicit.

Fortunately, government agencies are acknowledging the need for added responsibility, especially as it concerns AI and ML applications, which have attracted heavy scrutiny because of their potential to encode bias in their algorithmic models. A number of agencies, including the departments of Homeland Security, Health and Human Services, and Justice, for example, have issued AI strategies and policies that place a high priority on "responsible" or "ethical" AI use, but those strategies generally don't detail what that will mean in practice.[20] Responsible or ethical AI generally refers to a variety of steps that can be taken during the development and deployment of an AI or ML capability that aim to manage, monitor, and mitigate biases that may be intentionally or unintentionally embedded in the data being used.

Most agencies still have far to go in fleshing out protocols and steps that will enable them to design responsible AI systems and architectures in a systematic way. For example, a 2020 report by the Administrative Conference of the United States found that none of the numerous federal agencies it reviewed had established systematic protocols for assessing the potential for an AI tool to encode bias. "The upshot here, as earlier, is that developing internal capacity to rigorously evaluate, monitor, and assess the potential for disparate impact will be critical for trustworthy deployment of AI in federal administrative agencies," the report concluded.[21] Even the National Artificial Intelligence Research and Development Strategic Plan, issued by the White House in 2016, highlights the need to design architectures for ethical AI.[22] And while it describes a variety of considered approaches for doing that, the strategy leaves the challenge with individual researchers to figure out.

The Defense Department, which has been more aggressive than any federal agency in pursuing AI- and ML-enabled applications, has also been the government's pacesetter in adopting a responsible AI posture by formally adopting in 2020 a series of ethical principles concerning the use of AI. The recommendations came after 15 months of consultation with leading AI experts in industry, government, academia, and the public. The DoD's AI ethical principles apply to both combat and non-combat functions and encompass five major areas. For example, they require DoD personnel to minimize unintended bias in AI capabilities, employ methodologies to ensure the AI they are using is transparent and auditable, and maintain an ability to detect and avoid unintended consequences and the ability to disengage or deactivate deployed systems that demonstrate unintended behavior.[23]

Privacy and other ethical concerns follow many of the technologies emerging in the marketplace, not just AI. To help address this, the National Institute of Standards and Technology released in 2020 a draft privacy framework that sets an ethical foundation for data usage for technologies such as AI, biometrics, and the Internet of Things. "Getting privacy right will underpin the use of technologies in the future, including AI and biometrics, quantum computing, the Internet of Things and personalized medicine," said NIST Director Walter Copan. "These technologies all will be a big part of our future."[24]

While these steps are helpful, federal agencies in particular will need to give far greater thought to ethical considerations as they explore and expand their use of new technologies because of the highly sensitive nature of federal data and because of the government's significant impact on almost every aspect of our lives. In the case of AI, for example, there's a significant effort by DoD's Defense Advanced Research Projects Agency (DARPA) to flesh out how to make AI systems more understood and explainable to the people using them (as well as to others, such as courts and regulators that will have to make judgments about their efficacy, legality, and suitability).[25] This is a critical concern for many government agencies that operate in the law enforcement, medical, security, and other arenas.

Government agencies will need to develop a firm understanding of emerging technologies not just because they will need to evaluate them and use them—they also are increasingly being called on to regulate them as they proliferate across virtually every industry. Take distributed ledger technology (DLT), for example, which is being used or explored by a wide variety of industries—including finance, insurance, healthcare, agriculture, logistics, travel, and much more—to improve the transparency and veracity of transactions.[26] The Government Accountability Office called out the lack of regulation over DLT as a key challenge for some oversight agencies.[27]

The great diversity of technology capabilities available to government agencies and businesses today is creating limitless possibilities—but also new challenges. As agencies accelerate their innovation strategies to meet today's and tomorrow's mission demands, they need to be strategic—the technology choices they make today will have far-reaching impact. The architectures that federal agencies build today will determine their future.

Decision points

Fortify: Is your agency prepared to be a technology leader?

- Technology is reshaping the world and the government's place in it and this evolution went into overdrive in 2020. Revisit (or create) your vision for the future of technology by identifying what has accelerated, what has lagged, and what has changed forever.
- Evaluate current digital transformation efforts at other federal organizations and as well as at other state, local, and foreign government organizations that share similar missions with your agency. Accelerate investments in core technologies like cloud, data analytics, and mobility. Identify new avenues for digitally driven products, services, and customer experiences that leverage growing technology capabilities.

Extend: How are you creating an edge for achieving mission success with your technology choices?

- Focus on building technical wealth. Reimagine your approach to application development to take advantage of cloud capabilities, microservices, and the flexibility they unlock. Focus on creating reusable components that are maximally valuable, not just minimally viable.
- The future is here already. Begin piloting or scaling efforts and investments in next-generation technologies like distributed ledger, extended reality (XR), or AI to better understand how they can create new value for your agency's mission and business—and make sure you have a strategy for them.

Reinvent: How will your relationship with your agency's stakeholders be reshaped by next-generation technology?

- Conduct design thinking and strategic foresight exercises to evaluate how technologies can create greater value in those relationships.
- Make trust a core design principle of new technology strategies. Prioritize data privacy, ethical design, and continuous governance as you build and deploy new systems and services to promote trust and adoption among employees, citizens, and agency stakeholders.

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Trend 2

Mirrored World:

Digital twins report for duty

> The growth and convergence of technologies like the cloud, AI, machine learning, 5G, and IoT are propelling digital twins to the forefront as a critical tool for managing the enterprise.

At their core, digital twins replicate the performance of individuals, physical assets, and processes in a virtual environment to help us understand how these objects might behave under a variety of circumstances. Digital twins can even simulate complex scenarios in countless new and unimagined ways—using machine learning—to capture insights and present options and possibilities that might otherwise be missed.

This network effect creates a mirrored world where our physical world's often chaotic interactions can be digitally modeled, analyzed, and optimized. Leaders are starting to interconnect massive networks of intelligent twins to create living models of entire workplaces, warehouses, product lifecycles, supply chains, ports, mission spaces, and even cities. As enterprises build out these digital reflections of our working world, these capabilities will grow exponentially. Leaders will be able to make data and intelligence the primary orchestrators of the agency's business, increasing real-time agility at scale, and overhauling their innovation processes and potential.

Digital twins are already upending the way federal agencies plan, operate, and make decisions.

As with many of today's innovations, the federal government has historically fostered many of the concepts underlying today's intelligent twins. This includes fueling much of the early growth in computer simulation technology by modeling nuclear reactions, weather forecasting, car crash assessments, drug interactions, and flight simulators. But it was NASA's innovative use of simulators in 1970 to diagnose and repair the damaged Apollo 13 spacecraft from 200,000 miles away that served as the most salient precursor to today's digital twins.

The digital twin concept was first introduced in 2002, but the technologies needed to make the concept widely accessible have only recently reached a tipping point.[28] Key enabling technologies—data storage, computing power, cloud-based interoperability, wireless networks, machine intelligence, and miniaturized sensors—have now reached the level of maturity and price points needed to support the use of digital twins for enterprise applications. While computer simulation was once the primary domain of supercomputers, today's digital twins are accessible to any enterprise thanks to the scalable, more cost-effective compute capabilities of the cloud.

Digital twins build upon the computer-assisted modeling capabilities that have become staples of modern product development and systems engineering centers for two decades. But today's advances in AI, ML, and real-time data connectivity have advanced upon that concept by creating virtual models that are seamlessly and continually updated across a product's entire life cycle. The virtual model can now support the physical product's operation through direct linkage and representation of its more readily captured operational data. Changes experienced by the physical object now are reflected in the digital model—and the insights mined from the digital model now support decisions for optimizing the physical object.

Commercial companies utilize digital twin technologies to improve planning and decision-making in many sectors, including oil and gas, retail, logistics, manufacturing, infrastructure and transportation, and life sciences and healthcare, among others. But many federal agencies are employing digital twins in a variety of ways, including:

- **The Energy Department's Idaho National Laboratory (INL)** uses digital twin technology to develop next-generation nuclear reactors. These autonomous nuclear reactors will be highly secure and operate with unprecedented levels of monitoring, control, and supervision.[29]

- **The Air Force** used digital twins to assess cyber vulnerabilities within its global positioning system (GPS) satellites and systems.[30]

- **All three military branches** are using or exploring digital twins to improve weapons platforms and systems' maintenance and readiness. For example, the Air Force created a digital twin of a B-1 Lancer bomber to help develop better repairs for wing cracks and better predict points of structural stress for improved maintenance.[31] Likewise, the Army is creating a digital twin of the UH-60 Black Hawk helicopter to improve maintenance, producing parts that are no longer in production, assessing accident or battle damage, and evaluating repairs.[32] The Navy is similarly exploring the use of digital twins to improve aircraft mission readiness and sustainment of aircraft, including using it to test "what-if" scenarios, support predictive maintenance, calculate maintenance parameters, forecast aircraft behavior in different circumstances, and simulate maintenance scenarios.[33]

- **The National Institutes of Health and the National Cancer Institute** are researching whether digital twins can help doctors find optimal treatments for certain lung cancer patients.[34]

- And **the Homeland Security Department** is exploring whether digital twin technology can help U.S. Customs agents better track and mitigate risks associated with direct-to-consumer e-commerce shipments coming across U.S. borders.[35]

A future replete with digital twins is now being built, and today's initiatives signal that it isn't far off. The mirrored world will soon be the foundation on which enterprises form and test new strategies, collaborate with partners, operate faster and with more confidence, and more—in short, it's becoming their new mission control.

> 91% of federal executives report that their organization is innovating with an urgency and call to action this year.

The federal imperative for digital twins

Three things make digital twins highly compelling as a decision-support tool, whether in government or industry. The first, as discussed, is that they mimic the real world with unprecedented precision and accuracy due to their ability to rely upon real-world, real-time data. "It's not a new idea to construct a model of a physical system and run a simulation that emulates how it actually works," said then-U.S. Air Force Chief Scientist Richard Joseph. "With the development of computer technology, we've been able to do a better and better job to get closer and closer fidelity to the actual performance of the system."[36]

The second is that they operate as mathematical models—and models carry considerable power because they allow the decision-maker to change any number of variables and conduct unlimited 'what-if' analyses to model likely outcomes and effectiveness. Because they employ models, digital twins can modify an overall process with any number of variables—such as various resource allocations; the inclusion of automation, data analytics, or AI/ML; business process re-engineering; and policy changes—to see which combinations produce the most optimal outcomes.

A third feature that makes digital twins helpful to decision-makers is that they can remove blind spots. They identify potential points of contention, points of failure, early indicators of bottlenecks or subpar performance, vulnerabilities, inefficiencies, and spot where there's room for improvement. By layering machine learning algorithms onto a digital twin, the tool can analyze countless variables to model a vastly expanded range of potential scenarios that can impact the business or mission—including many scenarios that decision-makers may not be considering. In this way, digital twins can help agencies pivot to a more proactive posture on risk awareness and mitigation.

> "With the development of computer technology, we've been able to do a better and better job to get closer and closer fidelity to the actual performance of the system."
>
> ***Richard Joseph***
> *Former U.S. Air Force Chief Scientist*

These many features help explain why digital twins are becoming pervasive across so many industry sectors. This has forced many federal agencies to take notice and learn how they work and the many ways they can be applied. For example, General Electric and Boeing were early pioneers in using digital twins to develop aerospace products, and this has prompted one of their biggest customers, the Defense Department, to aggressively explore their potential for improved mission readiness, product development, supply chain integrity, and more.[37]

Another example of this can be found in the health sciences arena. Commercial medical device manufacturers are increasingly using digital twins to model both devices and patients to better design devices for people with specific conditions.[38] Some companies are using CT scans and MRI images to create three-dimensional computational models of individual patients that will help doctors decide on and prepare for surgeries or other procedures.[39] And this is prompting the Food & Drug Administration to examine how to regulate these products. The agency is even exploring how digital twins might play a role in its own regulatory processes. The FDA, for example, is collaborating with the French company Dassault Systèmes to conduct an *in silico* (computer simulation) clinical trial to evaluate whether a simulated three-dimensional heart can be used to test and evaluate new devices for the heart. "Modeling and simulation can help to inform clinical trial designs, support evidence of effectiveness, identify the most relevant patients to study, and assess product safety. In some cases, in silico clinical trials have already been shown to produce similar results as human clinical trials," said Tina Morrison, deputy director of Applied Mechanics at the FDA's Office of Science and Engineering Labs.[40]

The Interagency Modeling and Analysis Group (IMAG), which has members from roughly a dozen federal agencies, has acknowledged the considerable impact of digital twins on health sciences and is exploring the implications for federal healthcare and science agencies. "The healthcare industry is currently being disrupted by digital twin technology, where digital twins can represent diverse elements of the treatment process, ranging from medical devices to patients to healthcare delivery systems and other aspects of patient care," notes the IMAG website. "Tailoring treatment options based on the response of each individual patient is expected to be one of the biggest benefits. Another is the ability to detect and warn of an impending health issue before it occurs. Digital twin technology may also transform how treatments are deployed, unifying existing monitoring technologies into an integrated platform that can rapidly diagnose an individual's disease state and then evaluate treatment options based on knowledge of not only characteristics of the various therapeutic options, but also estimates of the patients current and future pathological condition. Therefore, digital twins will not only result in faster, safer, and more efficient healthcare delivery to patients, but also improve our definition and image of a healthy patient."[41]

Federal use cases for digital twins

Digital twins deliver value to an enterprise in many ways. Common use cases include:

- **Asset optimization.** With digital twins, leaders can subject a product, a system, or a business process to various modifications—such as the inclusion of an automated or AI-enabled component, for example—to see which delivers the best outcomes. It can inform managers how they can reduce their energy footprints, improve productivity, and reduce risk in their supply chains.

- **Assessing products and systems remotely.** Digital twins help visualize and analyze the status of physical assets that are not easily accessible, such as a satellite, a military asset on the battlefield, or a wind turbine.

- **Troubleshooting and diagnostics.** Employing analytics and machine learning, digital twins can suggest probable root causes of problems and run countless simulations to help select a plan of attack for repairing a problem.

- **Predictive maintenance and analyses.** The likely future state of a product or system, such as an aircraft component or an industrial facility, can be predicted based on innumerable scenarios. This capability helps ensure components that are at risk are inspected and replaced before they fail, improving maintenance and reliability. It also enables maintenance operations to shift from calendar-based, prescriptive inspection regimes to more data-informed, condition-based inspection models.

- **Route and traffic optimization.** Whether it is optimizing the flow of ground vehicle and aircraft traffic at an airport, vehicle traffic at a border station, maritime ships out at sea, car traffic in a smart city or military installation, or an agency's fleet or mail or delivery vehicles, digital twins can help agencies achieve greater efficiency and safety.

Many federal agencies are already employing digital twins to provide invaluable decision support for all of these use cases. For example, the U.S. is Navy employing digital twins for asset optimization on a large scale as it embarks upon a 20-year, $21 billion effort to modernize its four aging public shipyards, a program called the Shipyard Infrastructure Optimization Program, or SIOP. "This really is an... industrial manufacturing optimization program with a focus on productivity in the shipyards and how that affects the overall national defense," said Steve Lagana, SIOP program manager. "How do we get submarines in and out of shipyards as efficiently as possible, so the fleet commanders have the assets they need to do their mission?" Stephanie Douglas, executive director for logistics, maintenance, and industrial operations at Naval Sea Systems Command, said digital twins "allows us the opportunity to figure out how to optimize flow, not only within the shops, but around the yards to provide the most efficient and productive layout for operations within the shipyard."[42]

This is a large-scale example, but agencies can apply a similar approach to individual facilities or business processes. For example, agencies can use digital twins to model and optimize their facilities' carbon footprints or model options for rationalizing physical office space for the post-pandemic era.[43] The Office of Management and Budget (OMB) released guidance in March 2021 directing agencies to develop annual performance goals and track their progress to improve the delivery of government services and programs in key priority areas.[44] With digital twins, agencies can accomplish this with greater speed, precision, and confidence.

Supply chain optimization and resiliency is another growing use case for digital twins. The shocks of the COVID-19 pandemic and the March 2021 maritime interruption at the Suez Canal underscored the importance of resilient supply chains for both commercial and government enterprises. Commercial companies have been the pacesetters here, but federal agencies are following suit. A February 2021 executive order directs agencies to prioritize identifying and shoring up vulnerabilities in their critical supply chains and making them more resilient to potential shocks. By creating virtual replicas of their supply chains—consisting of hundreds of assets, warehouses, logistics, and inventory positions—agencies can use advanced analytics and machine intelligence to identify areas where real or potential value loss, risk, volatility, and uncertainty reside and where optimization is possible. Digital twins can inform logistics managers of potential scenarios and equip them to be more proactive, risk-aware, and evidence-based in their decision-making.

97% of federal executives report the COVID-19 pandemic created an unprecedented stress test for their organizations, ranking the greatest impact of this stress test to their organization as:

1. Their technology architecture
2. Workforce
3. Strategy
4. Processes

Along these lines, the Air Force is looking to digital twins to help secure the semiconductors and microelectronics that supply the military. The Air Force Research Laboratory (AFRL) is working with BRIDG, a Florida-based public-private-partnership, to develop a secure digital twin for semiconductor (SDTS) capability that will enable end-users to validate the integrity of a chip or assembly of multiple chips.[45] The effort will apply digital twin manufacturing concepts to develop data-driven, quantifiable security standards and methodologies for the fabrication of microelectronics. This should better protect the military's microelectronic components from malicious function insertion, fraudulent products, intellectual property theft, and reliability failures.[46]

Many agencies rely on distributed field operations that collect and generate large volumes of data, whether it's mail being processed, customs transactions at ports of entry, federal building operations, or depot maintenance activities. Digital twins can provide a framework for that data that can then be used to improve the effectiveness and efficiency of those operations dramatically.

Intelligent digital twins are driving a step-change in how federal agencies operate, collaborate, and innovate. And enterprises that get left behind will struggle to remain relevant in their mission areas as the industry sectors they oversee and collaborate with evolve technologically. Government agencies that start today, building intelligent twins of their assets and ecosystems, piecing together their first mirrored environments, will be far better positioned to succeed in a more agile and intelligent future.

89% of federal executives believe their organization requires a mission control, or central intelligence hub, to gain insights into complexities and model their organization's processes, people and assets.

Explore further

Fortify:

Unleash the power of data

To gain the organizational insights and greater agility the mirrored world promises, you first need a comprehensive and robust data foundation for your twins. When intelligent twins are connected in mirror environments, they are a powerful way to turn data into actionable, big-picture insights. But incomplete or incorrect data will lead to false conclusions.

High-quality historical data is critical for intelligent twins—it's what the twin uses to monitor real-time machine performance, build models of business processes and high-value assets, and more. But COVID-19 has made historic data increasingly unreliable. Everything from traffic and shopping patterns to energy consumption and international travel changed abruptly due to the pandemic. These anomalous changes in behavior and activity patterns have sent many machine learning models that have been trained on "normal" behavior off course, impacting supply chains, inventory management, marketing, and more.[47] Going forward, enterprises cannot rely on historic data blindly—they need to check and correct their models as the world changes.

On top of historical data, federal agencies need a strategy for real-time data collection, or they'll miss out on the real-time analytics intelligent twins can provide. There are two sides to this: investment in sensors and IoT devices to collect data and the tools to prepare, analyze, and visualize the massive amounts of information gathered. Today, many agencies are already investing in IoT devices and sensors, but some struggle to fully utilize the data these devices generate. New cloud-based services and platforms are being developed to bridge this gap and help enterprises achieve real-time insights. Snowflake, for instance, which Barron's recently described as a "growth juggernaut," offers clients data warehousing as a service, which can load continuously generated real-time data, requires no manual effort, and can even digest semi-structured data.[48]

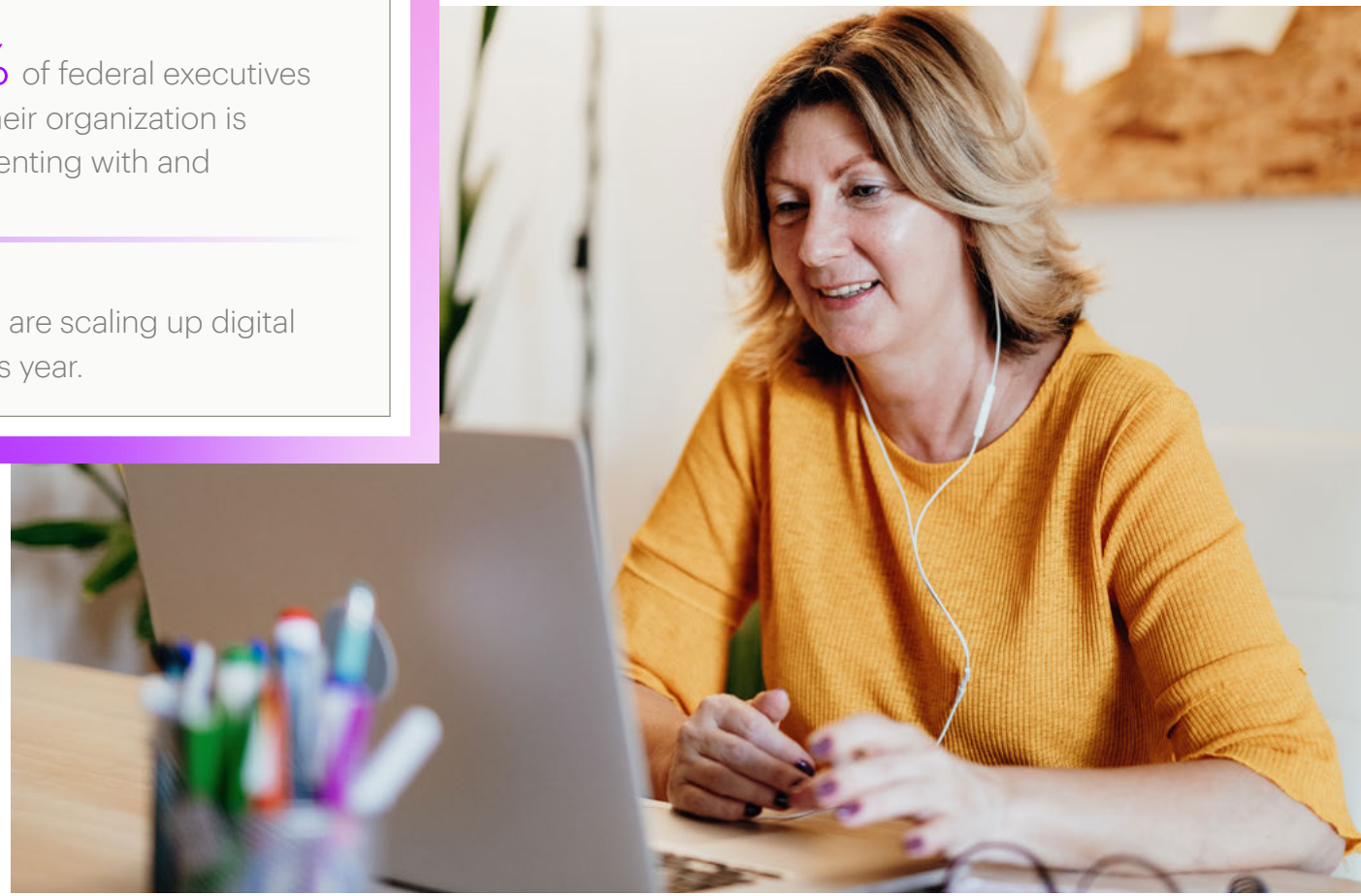
From there, intelligent twins can make real-time data actionable in the moment, as many of the examples above illustrate. Going even further, some enterprises are starting to explore how multiple intelligent twins, connected in mirror environments, can use real-time data to safely increase autonomy. GEMINA (Generating Electricity Managed by Intelligent Nuclear Assets) is a U.S. Department of Energy program funding research projects that use AI and digital twin technology to increase the flexibility and autonomy of nuclear reactor systems and reduce operation and maintenance costs.[49] Two of the projects to receive funding are tied to GE Hitachi's BWRX-300 boiling water reactor design. GE Research intends to move from time-based to condition-based predictive maintenance, which will lead to significant savings. To make this possible, they will develop an array of digital twins for continuous monitoring, diagnostics, prognostics, and early warnings for the reactors. They will also develop a "Humble AI" framework that defaults to a safe operation mode when confronted with situations the algorithm does not recognize. In doing so, the system ensures the secure handling of uncertainties and increases the feasibility of more autonomous operations.

As they continue building out their mirrored worlds, agencies will also need to think about data integration across multiple twins or multiple sub-components that feed into a single twin. API connections can help achieve that data synchronization, enabling different twins or components to connect and interact.

When built on comprehensive, compatible, and trusted data, intelligent twins and mirrored environments can help enterprises optimize operations, detect and predict anomalies, pivot to prevent unplanned downtime, enable greater autonomy, and dynamically adjust their designs and strategies with every new piece of data they collect or new test that they run. While each of these capabilities can save money and increase efficiency, their true value lies in what they represent together: a new way of understanding the agency's business and running it.

24% of federal executives report their organization is experimenting with and

13% are scaling up digital twins this year.



Extend:

A risk-free playground for innovation

Intelligent twins have powerful simulation capabilities, and with your data foundation in place, they will let you reimagine your innovation process. They are, essentially, a low-risk playground to explore new product ideas, strategize for many possible futures, and explore limitless "what-if" scenarios. While the adoption of digital twins is gaining steam in sectors such as energy, manufacturing, healthcare, defense, and logistics, many examples still tend to be more experimental and small in scale. But the capabilities they are demonstrating will only become more valuable when enterprises can tap into multiple twins in fully mirrored environments.

For instance, intelligent twins can completely transform product development. They enable AI-driven generative design, where human workers and AI systems iteratively work together, shrinking design and manufacturing timelines significantly. And they allow enterprises to complete more product testing in simulation, meaning they can put off physical manufacturing for much longer, saving time and money.

And this is precisely what the Air Force has in mind. The service successfully used digital twins to design, prototype, and conduct initial testing on its latest jet trainer aircraft, the eT-7 Red Hawk, thereby avoiding the time and expense of building a prototype. Former Air Force Secretary Barbara Barrett even boasted that the plane had flown "thousands of hours before it [took] off," and was "assembled hundreds of times before any metal [was] even cut."[50] The Air Force now intends to use digital twins to develop and test weapons and is building an online "Colosseum" in which vendors can show off their virtual weapons. Col. Garry Haase, head of the Munitions Directorate at the Air Force Research Lab, said AFRL plans to stage regular competition events in the Colosseum, each dealing with a different technology area.

For the Air Force, this isn't just a new, better way to build and acquire weapons systems. It amounts to a total transformation of the military's entire approach to modernization, says Will Roper, the Air Force's recent assistant secretary for acquisition, technology and logistics. Digital twins will play a central role in what Roper is calling his "Digital Century Series" concept for developing future combat aircraft." The idea of the 'Digital Century Series' is not about building aircraft that are different, but about building aircraft differently," he said. "The key tenet is a new 'holy trinity of technologies that would flip the pace of building new things and the price we pay for them." Those technologies include agile software development; modular, open-systems architecture; and digital engineering, including the use of digital twin technology.[51]

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When all aspects of a new weapon system—such as the aircraft design, all the components, the assembly line, the tooling—are digitally modeled, they can be easily optimized. "You can get expensive tooling out if you can find a better substitute. You can change a process from requiring an artisan with years of training to one requiring a lower skill level. The idea is to find a better way of assembling things, and raise the learning curve in the digital space, before you ever build the first aircraft," Roper said. "The ambition—which I think is completely achievable—is building the first airplane as if it was the hundredth."

This new concept, he said, aims to overhaul the decades-long approach the Air Force has used to acquire weapons. "With the Digital Century Series, we want to give profit in design, keep production rates low, never go to 'full rate' production, not by hundreds or thousands of things so that we can keep upgrading and modernizing, and re-competing who builds the next aircraft every few years. If we do this well, and digital tools become common industry practice, you don't have to be a producer of thousands to be a competitor. You can be a competitor as a great design company. And if this sounds like science fiction, it's already happened in the automotive industry. If we do it, we can start building cutting-edge aircraft every few years, and we can build satellites this way, as well."

From generative design to personalization to security, intelligent twin simulation is about bringing the right data and the right AI models together and exploring various possibilities, futures, and strategies from the safety of a twin. Soon, the mirrored world will bring this future-focused intelligence and agility to bigger stages, with more significant impact.

63% of federal executives expect their organization's investment in intelligent digital twins to increase over the next three years.

Reinvent:

Build the big picture

Today's federal agencies are not self-contained; they rely on partnerships, co-experimentation, and collaboration with other agencies, academia, industry partners, and stakeholder groups, and this must be reflected in the mirrored world. It's not always enough to have a real-time view of what's happening within your own organization. The full picture includes what's happening with the supply chains, vendors, research organizations, and interagency partners that you rely on too.

Europe is demonstrating one way that the mirrored world can increase big-picture visibility with its DigiTwins initiative, which aims to revolutionize healthcare by creating digital twins of individual patients that will enable healthcare decision-makers to identify optimal therapies, preventions, and health maintenance programs. The idea is to use digital twins of individual patients to safely simulate many treatments and outcomes, cheaply, and quickly before critical decisions are made. To do this, the DigiTwins initiative—which is supported by more than 200 partners from 118 academic and clinical research institutions and companies in 32 countries—is leveraging the vast knowledge base of its participating subject matter experts and organizations.

Here in the U.S., the Department of Energy's National Renewable Energy Laboratory (NREL) has developed a modeling and simulation toolkit that can create a digital twin of an urban area to assist researchers and city planners in quantifying the advantages and disadvantages of various transportation options. The Automated Mobility District (AMD) toolkit can create digital twins of the transportation systems in selected urban districts with which it can assess the mobility and energy impacts of various transportation options. "The AMD Toolkit moves past the basic analysis of connecting point A to point B," said NREL researcher Stan Young. "We are looking at accessibility of resources in the district—such as food, healthcare, entertainment, and employment—to its inhabitants and to outside visitors." In one example, the toolkit analyzed the impact of deploying a half-dozen shared automated vehicles (SAVs) at Clemson University's International Center for Automotive Research in Greenville County. The study found that adding the electric-powered SAVs would result in fuel savings of between 11 percent and 38 percent. But it also found that the addition of SAVs didn't improve the vehicle miles traveled, occupant-free miles traveled, or travel time.[52]

As more organizations digitize their physical operations and systems with intelligent twins, they will be able to share designs, information, and insights easily across silos and across ecosystems, virtually test how future products might work together, and conduct business in ways that were not possible before. How will your agency evolve when the power of comprehensive visibility, unlimited simulation, and safe experimentation is at your—and your partners'—fingertips?

87% of federal executives agree digital twins are becoming essential to their organization's ability to collaborate in strategic ecosystem partnerships.

Decision points

Fortify: Is your business prepared for the mirrored world?

- Audit your data practices. Evaluate what tools and technologies are being used and where data is being warehoused to deconstruct data silos. Identify where COVID-19 may have impacted historical data and its ability to drive accurate insights.
- Prioritize building streaming analytics capabilities. Digital twins will need a healthy data "supply chain" to be effective. Embed sensors in physical products and spaces, and invest in solutions that deliver rapid ingestion, preparation, and analysis of the data generated.

Extend: How can digital twins transform your innovation process?

- Develop a list of key use cases for where digital twins will generate the most impact in your enterprise. Reimagine how modernization planning, business process reengineering, resource optimization, supply chain management, and product development cycles would look with digital twins at the center.
- Integrate intelligence capabilities with digital twin efforts. Pilot generative design or synthetic data solutions to explore how they enhance design, testing, and product development.

Reinvent: How will your enterprise engage wider ecosystems of digital twins?

- Design twins from the outset with the intent to connect them across the agency enterprise or ecosystem. Make API strategy a priority when developing digital twins. This includes evaluating and including external (or open) sources of data and ensuring the construction of an API for the twin itself.
- Have ecosystem-scale thinking lead digital twin strategies. Target large systems as the long-term target digital twins. Think entire offices, supply chains, and more. Use individual twins to gain greater visibility into larger collaborations.
- Short-list potential digital twin-driven partnerships. This could be collaboratively building a new twin or tapping into an already established network of digital twins.

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Trend 3

I, Technologist:

Empowering innovators in the workforce

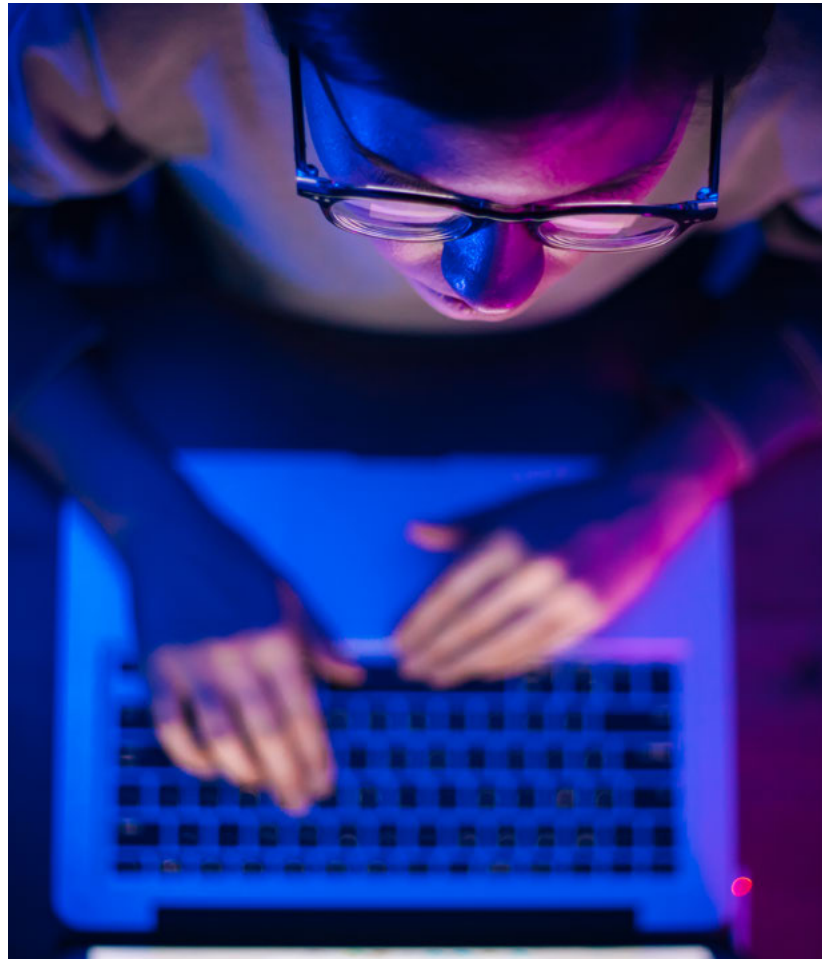
> As we learned all too well this past year, technology is vital to the mission. And this requires that technology be democratized and accessible across the agency. Democratized technology means that everyone—not just the IT department—must appreciate technology's vast potential and be empowered and proficient in deploying it to achieve new levels of capability to advance the government's varied missions and businesses.

This has already begun. We see federal employees of all stripes employing a wide variety of emerging, mostly cloud-based platforms and tools to create custom dashboards, run data analytics, launch low-code or no-code applications, and even introduce automation and AI into their workstreams. Going forward, these technologies will empower individual employees to determine their own individual requirements for fixing problems and improving processes, select the right technologies and tools, for the task, and then address those requirements as a self-service.

But this trend brings with it sweeping implications for agency leaders to think through. A big one is that the role and function of IT will have to adjust accordingly. No longer can IT be the gatekeeper for all things IT. Rather, it must shift to becoming more of an enabler, a governor, a collaborator, and an advisor to the mission and business sides of the agency as they assert greater autonomy in deploying technology. Increasingly, successful IT departments will need to make this shift core to their missions and strategies.

Another implication when technology is democratized is that, even as our day-to-day work platforms and tools get easier for everyone to use, there remains a great need for federal agencies to educate their workforces to be savvy users and consumers of the technologies available to them. Whether they are advancing the agency's mission out in the field or tending to the back-end business side of things, all employees will need a foundational level of technical and data literacy going forward.

In the longer term, expect "I, Technologist" to evolve the agency's culture. As employees grow more comfortable and competent with employing technology tools and re-engineering their work processes, they will foster a culture that is far more adaptable, nimble, and confident in meeting the challenges of the future.



Now we're all developers

In July 2020, OpenAI asked for help exploring the capabilities of GPT-3, the third generation of the organization's deep learning language model which can generate human-like text.[53] Using a private beta version of the model, developers got to work, discovering and experimenting with its ability to write short stories, songs, guitar tabs, an article about itself, and even software code. Each new discovery and demonstration sent waves of excitement and awe across tech workers, reporters, and business leaders alike. When one developer testing the model was able to tweak it to produce code, demonstrating that he could create webpage layouts by giving the model written prompts like "the Google logo" or "a blue button that says Subscribe," many wondered if this was an opportunity to make programming more accessible.[54] With the help of a tool like GPT-3, could anyone become a developer?

They weren't far off. An undeniable shift is underway: Powerful technology capabilities are being put into people's hands, usable without highly specialized skills. It's not about a single tool or service, but the culmination of an array of democratizing technologies. Natural language processing, low-code platforms, and robotic process automation (RPA) are just a few of the capabilities and services making technology more accessible. They each have different and unique applications, but all are bringing the innovative power of machines into the hands of people with as little friction as possible.

Democratized technology lets people optimize their work or fix pain points on their own. Without needing to request major IT projects, people can create a custom dashboard for a group's finances, build an app to approve and automatically fulfill purchase orders, and much more. Suddenly, the power to create technology solutions is entering the hands of people across the enterprise.

This doesn't remove IT from the equation. IT will still lead big implementations, scaling successful programs, and refreshing technology used by the agency. But this does require a shift in the role of IT departments. More than ever, they will need to collaborate with business and mission teams to identify and integrate innovative new technologies and ensure they are using and developing new tools and platforms securely and efficiently.

This shift is every agency's opportunity to make their employees a core part of their digital transformation effort. But to do so successfully, leaders will need to extend the innovation imperative across every business unit. It's not just about giving people access to new tools; agencies must actively teach their people to think like technologists. This doesn't mean turning everyone into an engineer, but rather enabling them to solve problems with technology.

By empowering everyone, those closest to a problem can be the ones to create solutions, keeping the agency in lockstep with rapidly changing needs.

Democratized tech is a game-changer for federal agencies

Regardless of what your federal job title is, consider yourself a GS-2210! (That's an "IT specialist" for readers who are not federal employees.)

Technology is simply so pervasive and so fundamental to getting the government's work done that every federal employee may soon have technology in their job description. Take Alex Measure, for example. Measure is an economist at the Bureau of Labor Statistics whose job was to manually classify data to help statisticians figure out things such as what are the most dangerous occupations and what are the most common injuries in those occupations. Measure decided he could save countless hours of time by automating the analysis and classification of hundreds of thousands of Survey of Occupational Injuries and Illnesses filings annually—so with the approval and support of his managers he went ahead and did it!

"Well, I got started out of personal interest as a new economist," he shared on the Exploring AI in Government podcast.[55] "It was my job to review some of this data by hand and to classify it by hand and it's not the most glamorous thing to do. So that got me interested in machine learning and then that got me interested in learning about these techniques and applying these techniques. And so, it sort of went from there."

It helped that there was a pretty solid business case driving him to think like a technologist. "In the case of the survey of occupational injuries and illnesses, each year we're collecting 300,000 written descriptions. We have dozens of people around the country that are manually reading through each of these descriptions. And obviously that takes a lot of effort. We estimate it takes about 20,000 hours of labor. Each year is equivalent to about 10 full time employees working on nothing else. So, you know, clearly there was a very real resource cost there," he said.

Technology is simply so pervasive and so fundamental to getting the government's work done that every federal employee may soon have technology in their job description.

But what made the task of automating this part of his job *possible* was the ease of the available tools, he said. "The advances in the tools have been amazing over the last 10 years. And I think if you went back 15 to 20 years, it was actually very hard to implement these systems. And now you have libraries like the scikit-learn library and Google TensorFlow, AWS Pytorch, that make a lot of these things much easier to build and implement. So, one of the things I spend a lot of time on in my current role is actually teaching my colleagues how to implement these systems and many of them have gone on to implement various successful systems."

Not bad for an economist. But the power of Measure's story is that similar examples of grass-roots tech creation are happening all over and becoming the new norm. A tectonic shift is occurring today in the way enterprises develop and deploy applications that run the business, modernize operations, and serve customers. And this shift arises out of an unabated appetite for new software by people who are trying to keep pace with their growing mission and business demands by harnessing data analytics, AI, and automation tools. That appetite has now far outstripped the capacity of traditional code-based programming approaches. Traditional code-writing simply takes too long, is too expensive, requires qualified programmers that are in short supply, and yields products that too often fail to satisfy specific end users' needs. Conversely, low-code tools, robotic process automation (RPA), and other democratized technologies are proliferating rapidly, offer enterprises a more compelling option for building powerful capabilities than traditional software development because they solve the problems of scale, speed, equity, and customized requirements at the individual level.

Sensing the enormous appetite for grassroots tech, just about every major cloud and software vendor has obliged with new tools that are now ubiquitous: Microsoft Power Platform on Office 365 and Azure (even Windows 10 now includes Power Automate Desktop that can apply RPA to automate tasks), Amazon Honeycode on AWS, AppSheet on Google Cloud, Lightning on Salesforce, APEX on Oracle, and Appian are just a few. Many of these tools offer visual interfaces with a simplified drag-and-drop approach to building business application software instead of traditional computer programming. And, in most cases, all components of the software, such as frontend and backend code and configuration files, are generated automatically using industry best practices.

Grassroots tech creation—that is, encouraged and sanctioned by managers—is happening in greater abundance across the commercial sector. According to market research firm Gartner, 41 percent of non-IT employees customize or build IT solutions, with business buyers expected to represent more than half of low-code clients by 2025.[56] And as illustrated by the example of Alex Measure at the BLS, this trend is taking root in the federal market as well.

> **89%** of federal executives believe technology democratization is becoming critical in their ability to ignite innovation across their organization.

The considerable ripple effects of "I, Technologist"

Most things are in place for democratized tech development to become commonplace in government: the demand, the tools, the business cases. What's not yet in place, however—largely because this is moving so quickly—is the consistent leadership, planning, skilling, and governance needed for agencies to capitalize on it.

This is where agency leaders need to strike a careful balance. What's most attractive about democratized tech is that it enables the agency to dramatically improve productivity, mission performance, and business performance despite existing challenges around large-scale IT modernization and shortages of IT talent in the ranks. But there's a threatening aspect to this as well: agencies must ensure that all this grassroots activity is adequately secured, understood, and integrated into an enterprise framework set forth by the agency's IT leaders.

For agency leaders, there's urgency in figuring this out. Just as apps like Excel and SharePoint empowered employees to more effectively collaborate, track and manage data, and share and convey information, so too are today's development tools allowing them to automate, streamline, analyze, and accelerate their job tasks for improved performance and service delivery. There are valid and serious concerns that must be addressed, but simply saying no to grassroots tech is not really an option—employee expectations are shifting rapidly and people won't remain where they're not enabled to succeed.

Specifically, we see three big implications of "I, Technologist" that agency leaders will need to give careful thought to:

1. **Do-it-yourself IT** will accelerate as business and mission units become more comfortable with building their own applications.

2. **The role of IT** will shift as business and mission units assume more control over their own IT provisioning and development.

3. **Tech skilling** will take on higher importance so employees can be smarter about how they employ these new tools and capabilities.

Saying goodbye to shadow IT

Shadow IT—that is, hardware and software that is not sanctioned or provisioned formally by the agency—has long been a challenge to agency IT departments. Mission and business team members install shadow IT because it helps them meet specific work-related needs that their agency-sanctioned hardware and software does not. And IT departments understandably guard against shadow IT because it can pose significant cybersecurity and other risks to the enterprise.

So unsurprisingly, the concept of democratized technology poses big, vexing questions for agency IT shops: people now have an increasing temptation to circumvent their IT departments by downloading cloud-based, drag-and-drop tools that allow anyone to custom-build whatever business capability they might need, whether it's to analyze data, automate a process, or infuse artificial intelligence into a business task. Many agencies are still trying to understand what these new tools mean for them and have yet to formulate guidelines for their use.

If "I, Technologist" is managed well, agencies can minimize their shadow IT problems by enabling their business and mission teams to develop needed capabilities using agency-approved platforms and tools, all with the aid and support of their IT departments. To accomplish this, agencies leaders must balance and harmonize these two powerful and valid competing interests within their enterprises. IT departments must work more in tandem with their mission and business colleagues to ensure they have the tools and platforms they need to get their work done. And mission and business teams must work within the confines outlined by their IT departments.

For this to work, IT shops must work much more closely with their mission and business customers to understand their needs and be responsive in providing the capabilities to address those needs. Cloud-based natural language processing, low-code platforms, RPA and other accessible tools and platforms make this kind of relationship possible because they are so easy to use, scale, and configure to meet agency policies. Success will rely not on mission and business teams doing their own thing, but rather on IT departments and their mission and business customers developing a more constructive synergy so the legitimate needs of all parties are met.

The Department of Veterans Affairs is taking a novel approach by offering employees a wide array of easy-to-use applications that are pre-vetted for security and interoperability. "You have to give your customers options. If they don't feel like they're getting serviced properly from the central IT function, they'll go find their own way, because they've got a mission to execute," says Dominic Cussatt, the VA's principal deputy chief information officer.[57] Cussatt said the VA is creating portfolios of services that customers can shop from and utilizing a Systems-as-a-Service platform that will enable employees to access and shop for things like a customer relationship management tool or call center option, using their own funds to access them. Similarly, agencies can whitelist various low-code and no-code development tools and platforms for their agency business teams to use and experiment with.

In other words, agency IT departments will need to collaborate more with their business and mission end users, supporting and enabling them as they explore and experiment with tools available in the marketplace. IT shops can do this by ensuring those tools are sufficiently monitored, optimized, and secured, and then, as those tools and resulting applications prove their business value, they can help scale them across the agency enterprise as needed to benefit others. IT departments might even consider establishing centers of excellence within their agencies (several have) so business and mission teams can learn best practices, find inspiration, and adopt previously successful approaches.

If done well, there is no reason for there to be shadow IT—instead, the needed tools and platforms are properly integrated into the network ecosystem. This is far better, from an IT department's perspective, than not knowing what's being used at all.

Another important piece of this strategy is an acknowledgment that mission and business teams often know better than the IT department what they personally need. As with Measure at the BLS, the mission and business teams must be allowed to experiment—safely and securely—with available tools and platforms to fashion capabilities that are tailored to their specific needs.

Finally, the capabilities that are developed for business and mission use cases through this collaboration must be viewed as living systems that are continuously in need of monitoring, optimization, and advancement. This requires agile approaches both on the part of IT departments and the business and mission teams that create and use them.

Agency IT departments can take other steps to better address the challenge of shadow IT, such as:

- **Open more lines of communication with IT users.** Learn more about their business and mission needs and where existing IT capabilities fall short.
- **Educate IT users.** Agency employees need to better understand the risks involved with shadow IT and how IT may be able to meet their business needs. Also, teach business users what they need to know about building new applications, working with AI and machine learning, and making the most of modern development tools.
- **Balance risk with rewards.** Not all DIY tech poses the same threat, so assess and mitigate the risks appropriately.
- **Streamline governance.** Adopt an IT governance structure that facilitates innovation through the use of new technologies that are identified, vetted, available, and provisioned for IT users at a rapid pace.

Ultimately, the goal is to have the organization consider IT a trusted resource that can help achieve business and mission objectives quickly and innovatively, while saving money and protecting the company from risk.

The role of IT: What's left for IT departments to do?

Many agency IT departments have multiyear plans in place to modernize their infrastructures and processes, to streamline and automate and tear down silos, and, eventually, to become more agile and responsive. "I, Technologist" now allows IT's customers to avoid some of this wait and go it alone, using IT-sanctioned tools and platforms. It augurs a new era in which the business and mission customers of IT have the wherewithal to quickly spin up DIY tech solutions that address their specific needs and pain points.

Where does this leave IT? At its core, this challenge is about re-inventing how IT and non-IT employees work together to embrace secure, agile innovation at all levels that advances the mission and the business. This can happen, in part, if IT departments put guardrails in place to ensure a safe zone for the business and mission units to experiment and create. This will require some strategic stacking (see Trend 1), such as creating data lakes that people can access to extract insights that will help them succeed or secure enclaves where employees can experiment safely.

Other guardrails could include:

- Pre-vetted tools, technologies, and platforms that business units can use to design, build, test, and deploy prototypes. These should include open-source tools, DevSecOps platforms, and low-code/no-code solutions. Because these tools, technologies, and platforms are always advancing and changing, the task of vetting and approving is continuous.

- Responsive technical security assessments to ensure new products are compliant with security, ethical AI, and other policies. Authorities to Operate (ATOs) will need to be re-evaluated, streamlined, and accelerated, and we are seeing some progress with this in the Army, Air Force, National Geospatial-Intelligence Agency, the Intelligence Community, and the General Services Administration.[58]

- Concept-of-operations documents and other needed guidance and policies. This could include, for example, frameworks, best practices, reusable patterns, and qualifying criteria and training for people to create their own capabilities.

Because platforms and technologies are constantly changing, those guardrails will need to change at pace and be well communicated to maintain transparency with the technology user community.

Another way some agencies are promoting greater collaboration and alignment between IT and business teams is by shifting from a project-based mindset to more of a product-based mindset focused on product development and lifecycle management. The U.S. Patent and Trademark Office, for example, organizes its IT projects across four product lines—patents, trademarks, enterprise, and infrastructure—and they range from new software for internal use to products for patent and trademark applicants.[59] The way some organizations are doing this is by emphasizing different performance metrics for IT—for example, putting less focus on things like IT throughput and efficiency and more on business outcomes.

Other important new roles that IT departments will need to play going forward include:

- Scaling solutions that work across the enterprise so others can benefit from them
- Educating business and mission units to be more tech and data literate
- Staying ahead of technology so they can serve as effective consultants to business and mission units as tools, processes, and platforms continue to evolve

This new era of democratized tech will raise important questions about how IT departments can best support their agencies. But it's important to understand that, while the role and function of IT departments may shift, these organizations can become even more critical to the success of the agency.

Another way some agencies are promoting greater collaboration and alignment between IT and business teams is by shifting from a project-based mindset to more of a product-based mindset focused on product development and lifecycle management.

Training: A new urgency for digital fluency across the enterprise

Here's a helpful way to think about "I, Technologist": There's long been a divide between the business and mission parts of an agency and IT simply because IT is so specialized and technical. As technology becomes more synonymous with the business and the mission, it is critical to close that divide. In short, there are two ways to bring people and IT together into a productive working relationship. The first way is to make technology accessible to all employees via user-friendly tools. The second way is to skill people up to work with these technologies and establish a closer working relationship between that business unit and IT. Most of the progress bringing us to "I, Technologist" falls in the former category. But there's still a big need for the latter.

While we can mask some of the complexity associated with creating applications, an understanding of the underlying basics is still needed to apply these tools effectively and do so securely. For example, we still need to know how to think about the data we're working with so we get to our desired outcomes. In short, we can't just be technologists because the tools are easier to use, we also need to *think* more like technologists.

So, what do federal employees need to learn? In short, they need to know enough about what current technology is capable of so they can formulate clear ideas about how to improve their business. Whether it's a smartphone, edge computing, RPA, AI, or something else, people can't conceive of how the latest technologies can help them until they understand them sufficiently. And that understanding must exist at all levels—leadership, managers, supervisors, and employees—for true innovation to take root across the enterprise.

We call this digital fluency. Digital fluency encompasses a wide range of skills and knowledge, to include:[60]

- **Digital foundations:** A conversational understanding of core digital technologies and concepts, including cybersecurity, cloud computing, automation, AI and ML
- **Cloud value optimization:** The ability to establish a business case for cloud value realization, evaluate progress, and ensure ROI
- **Cross-functional collaboration:** Being able to orchestrate across functions to drive common business priorities
- **Data-driven leadership:** The ability to use data to accelerate decisions and respond in real time to dynamic situations
- **Customer centricity:** Understanding customer value and how to delight customers with world-class experience
- **Innovation culture:** Being able to foster continuous learning, creativity, and strategic risk-taking

A few federal agencies are offering digital fluency training to their employees. Perhaps the most fully formed example of this is at the U.S. Air Force, which launched the Digital University in 2020 to advance the service's Digital Air Force initiative.[61] The program offers more than 12,000 courses from Udemy, Pluralsight, and Udacity at no-cost to all Air Force and Space Force professionals.[62]

Another example is the U.S. Department of Agriculture. The agency's CXO Dashboard program integrates data from systems spanning 29 agencies and staff offices into a comprehensive suite of self-service dashboards spanning seven administrative functions.[63] However, providing managers with sufficient data literacy is critical to making best use of this powerful tool. The agency's acting Chief Data Officer for Rural Development, Jim Barham, launched an effort to enhances the digital fluency of his staff, working to identify current skill gaps and developing targeted training to best leverage this platform.

All federal agencies are struggling to hire people with digital and data literacy, which makes the task of reskilling and upskilling existing employees so critical. And the escalating pace of technological change means that demands for skilling will only grow.

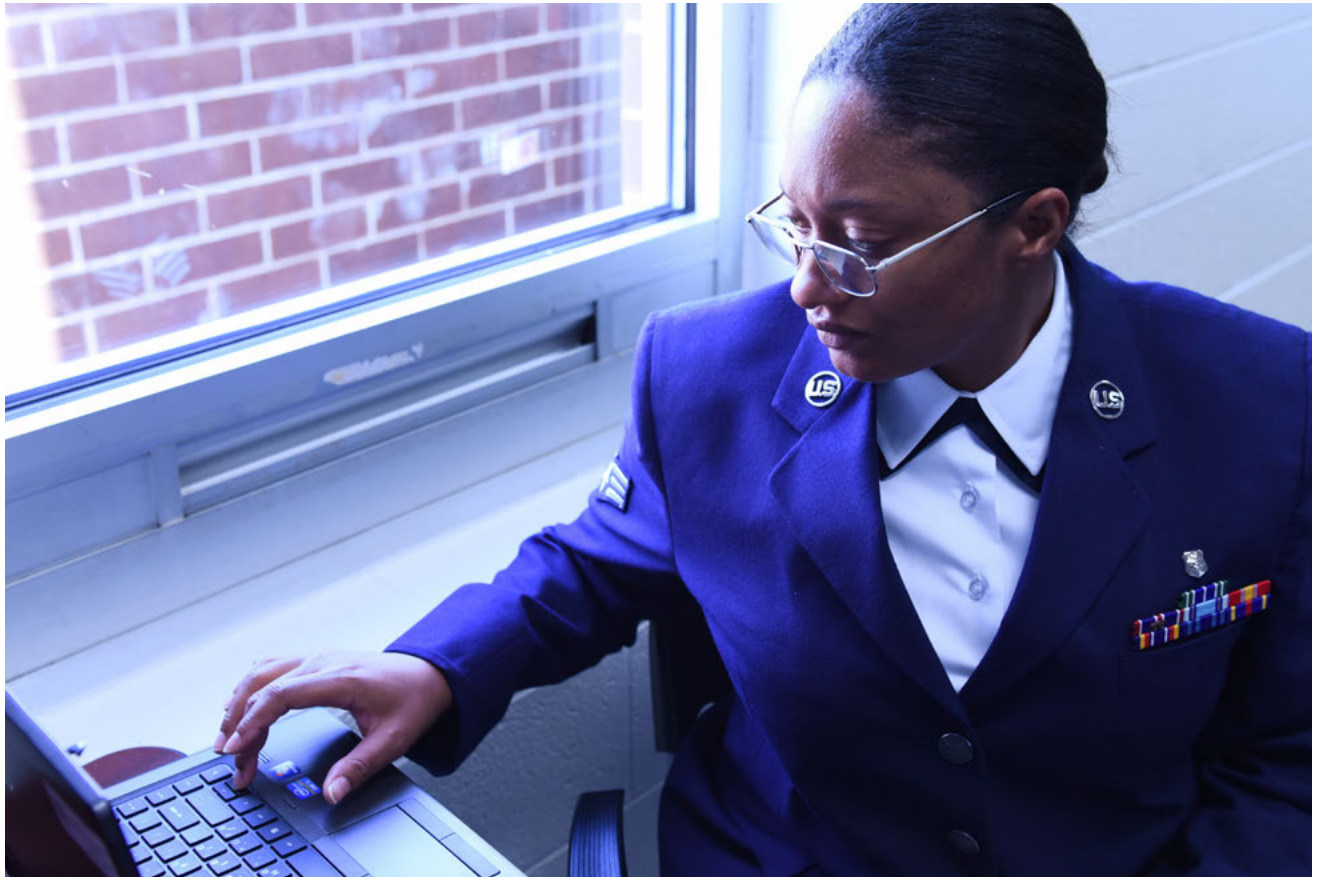
89% of federal executives agree that for tools of technology democratization, organizations need to ensure that training strategies include a focus on security and data governance.

Explore further

Fortify:

Bypass the skills gap

For years, many government agencies have had great ambitions for their digital transformations, but they've struggled to recruit and keep the highly technical workers needed to bring those plans to life. Seven in 10 IT leaders surveyed from the federal government and industry say that continuing IT skills gaps have a high or medium impact on their agencies' ability to execute missions, one recent report found.[64] Among the skills that survey respondents said were most needed over the next two to three years: cloud application development (53 percent) artificial intelligence (49 percent), and data analysis (47 percent), software development (32 percent), and RPA (22 percent). The demand for rapid digitization in response to the COVID-19 pandemic threatens to push those numbers even higher.



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Many government agencies and companies may have been looking at this problem too narrowly. Even as specialized technical skills remain in high demand, enterprises can increasingly lean on technology democratization to circumvent the skills gap in many areas, including all of the skill areas mentioned above. It's a parallel strategy that will further close the disconnect between workforces and the technologies needed to deliver the most creative solutions in today's market.

RPA, for instance, allows people with different types of skill sets to automate repetitive tasks. Instead of having a team of software developers writing software packages to automate particular business functions, NASA is using easy-to-use RPA tools to automate hundreds of business tasks across the agency through a shared services center. As of November 2018, NASA had more than 300 automation projects in the pipeline—mostly in human resources, procurement, financial management, enterprise services, and agency business services—and more than 10 projects were operational, according to Kenneth Newton, director of service delivery at NASA's Shared Services Center. What's important is that these projects were all suggested by the employees performing those functions, Newton said.[65]

These democratized technologies may be new ground for many organizations, but there's good news on that front too. With the shift to cloud underway, you're headed in the right direction, and may even have access to these tools already. Existing cloud solutions offer a stepping stone into these spaces. Amazon's Honeycode, for instance, is an AWS service that lets people build mobile and web apps without writing a single line of code.[66] Salesforce's Lightning App Builder is a point-and-click tool for creating custom pages on the Salesforce app.[67] For the many organizations migrating their people to Microsoft Teams, Power Apps can be directly embedded.[68] These tools, and many others, offer an incredible opportunity to bridge the gap between complex technology and workers at every level of the organization.

Even as specialized technical skills remain in high demand, enterprises can increasingly lean on technology democratization to circumvent the skills gap in many areas.

81% of federal executives agree their organization must train their people to think like technologists—to use and customize technology solutions at the individual level, but without highly technical skills.

It's easy to see these examples as a story of speed and efficiency alone. But there is a far more profound message underneath. When access to powerful technology capabilities reaches throughout an organization, every employee can be an active and vital part of the digital transformation effort. People can pick and choose for themselves what to automate, allowing them to focus on the things they do—and like doing—best. They can create solutions for their own work processes and for their customers right at the point of need. They can help to improve both the customer and the employee experience—not by gathering feedback to send to a team of tech experts for consideration, but by putting technology to work themselves.

The fact is, even though many agencies struggle with shortages in IT skills, they have plenty of employees anxious to solve problems and meet their business needs through technology. With the right technologies, in many cases you have the people you need. From startups hoping to quickly establish themselves among more seasoned competitors to legacy organizations working to complete their digital transformations, enterprises can use democratized technology to reduce the impact of their skills gaps. Leaders in the future will be the ones who rethink their approach to meeting their skills needs. It's no longer just "who can I hire?" but "how can I empower?"

51% of federal executives report creating scalability and resilience as a benefit their organization derives from tools of technology democratization, while

49% of federal executives report accelerating solution implementation and interconnectivity as a benefit.

Extend:

Activate grassroots transformation

Agencies and businesses are already using the tools of democratization to speed up and automate work processes and enable greater agility in one-off or limited instances. But it's not enough simply to have the tools and the training in place. To truly capitalize on today's capabilities for technology democratization, agencies also need to build a culture of innovation and collaboration so their people feel encouraged to put their tools and digital fluency into practice. Federal agencies, as a group, have had mixed success with this.

> "Innovation takes time and energy for an organization, but when leaders provide their employees the space to experiment, they can often tap into their employees' passions for their work and the product."
>
> ***Brian Fox***
> *Former Systems Development Branch Chief at the U.S. Geological Survey's National Geospatial Technical Operations Center (NGTOC)*

No two agencies are alike, so tactics and strategies will vary and approaches that work well in one agency may not work at another. Things like rewards, incentives, gamification, competitions, and dedicated innovation time during the work week, can all play a role. But what's most important is that employees feel safe and encouraged to experiment, fail, and try again. To do this, agency leaders need to create safe zones for experimentation, risk-taking, creativity, and, yes, failure. Creating agency-wide forums and venues of collaboration are also critical so your people don't feel alone in taking risks and experimenting and can share their experiences and learn from each other.

"Innovation takes time and energy for an organization, but when leaders provide their employees the space to experiment, they can often tap into their employees' passions for their work and the product," Brian Fox wrote in a blog when he was the Systems Development Branch Chief at the U.S. Geological Survey's National Geospatial Technical Operations Center (NGTOC).

Fox, currently a strategist with the 18F digital services delivery team at the General Services Administration, emphasizes that experimentation is an essential ingredient of innovation: "Most innovations aren't planned, and companies like 3M know this, allowing substantial time for their employees to experiment on their own (15% of their time!). The 3M Post-It notes that are probably on your desk as you read this are a great example of this 'freedom to experiment'—a 3M engineer determined on his own that an adhesive that failed in its initial development could be used on the back of paper to create a great way to tag and keep small notes.[69]

Another critical piece of innovation is collaboration, not only within the agency but also with other agencies, industry partners, non-profits, or academia. For example, there are many federal organizations that regularly assist agencies with their innovation efforts, including:

- GSA's 18F, Centers of Excellence, and Technology Transformation Services
- The federal RPA Community of Practice
- The Defense Department's Defense Innovation Unit
- The Census Bureau's xD Program
- The Commerce Department's Opportunity Project

Some additional tips that will be helpful for any agency striving to promote grassroots innovation include:

Articulate and promote an overarching innovation vision. Each agency will need to think of what innovation means in the context of their set of missions and business. It is important to define what that will look like so all employees understand where they are heading and why it's important. And that vision should have linkages to every employee so they understand how they fit into that picture and what is expected of them.

Make sure agency leaders are visible throughout. Government workspaces have historically not embraced concepts such as experimentation, creativity, and acceptance of failure. But these are all important to establishing a culture of innovation, so it's important that people see their leaders as actively encouraging this by attending and speaking at innovation events and promotions.

Dedicate time for innovation and training. Government employees don't have a lot of free time in their workday. So, agencies may need to carve out dedicated time during the work week for training and innovation so employees feel safe including that time in their schedule.

Include innovation in everyone's job description and performance expectations. Innovation doesn't happen when an organization creates a chief innovation officer responsible for making innovation happen. It happens only when everyone understand that innovation is embedded as part of their job and they will be held accountable for it.

Reinvent:

Power your new innovation engine

The value of technology democratization and wide-scale technology training will only grow over time. Leaders in this area are unlocking more freedom and exploration for employees. Consider, for example, the impact that just one segment of democratized technology—RPA—is having at agencies across government. A low- to no-code commercial-off-the-shelf (COTS) technology, RPA can automate repetitive, rules-based, low-value tasks, such as data entry, data reconciliation, pre-populated responses to customer inquiries, scheduled communications, spreadsheet manipulation, automated data reporting, and analytics, to name a few.

"Nearly two years after the first Robotic Process Automation (RPA) application was deployed in the federal government, RPA has become a widespread process automation tool," said the November 2020 *State of Federal RPA* report, published by the Federal RPA Community of Practice (CoP).[70] The report found that overall RPA program maturity increased significantly in fiscal 2020 and that RPA programs have reported strong demand for automation solutions within agencies. A use case inventory posted on the RPA CoP website documents more than 300 RPA use cases—mostly in resource management, administrative, and business areas such as logistics, human resources, financial management, IT, and procurement. The use cases cut across the federal government, including the Defense Department, Treasury Department, Veterans Affairs Department, the Centers for Medicaid and Medicare Services, the Food & Drug Administration, and many other agencies.[71]

Just in the period between 2019 and 2020, the number of automations deployed at federal agencies increased from 219 to 460, a 110 percent gain. The impact of these initiatives are far more impressive: annualized hours saved by automations increased from 285,651 to 848,336, a 197 percent increase. Moreover, the average hours of annualized capacity created per automation increased from 1,335 hours per automation to 1,708 hours.[72]

At the National Science Foundation, for example, an employee had an idea to save time: a bot that automates so-called nag notes, which are notes that remind people of upcoming public meetings. Because the agency plans thousands of meetings a year, the agency estimates the bot will save 25,000 hours a year in administrative staff time. The NSF's CIO, Dorothy Aronson, said in an interview that she was delighted to see how an NSF employee who didn't have much prior technical training was able to employ a technology-enabled solution that ultimately benefited the whole agency. "By working as a partner with the IT shop, she learned a lot about how IT people think, so that partnership was really important in her personal growth," Aronson said.[73]

The pace of transformation will no longer be limited to how quickly IT teams can roll out new solutions, nor will the scope of transformation be limited by non-IT workers' expertise with tech capabilities. Enterprises equipping their people with democratized technology are building the foundation for greater agility and ability to scale now and in the future.

Without taking steps to empower your people in this way, you'll be holding back your own digital transformation. Government agencies and industries are adapting and transforming around you, and your employees' and customers' expectations are evolving accordingly; your organization must evolve in kind.

Decision points

Fortify: Is your enterprise poised to take advantage of technology's growing democratization?

- Pick one area of the enterprise to begin experimenting with technology democratizing solutions. For instance, give your resource management functions the tools needed to design their own apps and automate workflows.
- Evaluate your existing access to democratized technology. Many cloud providers are beginning to include RPA or low-code solutions as part of their services. Identify what tools the enterprise may already have access to, or what additional investments need to be made, to power grassroots innovation.

Extend: How are you training your workforce to think like technologists?

- Establish skilling programs that help workforces become digitally fluent so they understand the basics of cybersecurity, data literacy, cloud value optimization, and more. The more they understand these concepts, the more they will be able to use democratized technologies to their full potential.
- Ensure plans to adopt democratized technologies are accompanied by checks and balances that allow for easy identification of risks in low-code software, Office 365, RPA, and other tools.

Reinvent: How can democratized technologies make IT groups more effective—and vice versa?

- Establish teams to support and guide the use of democratized technologies across your organization. Update IT policies to give employees flexibility to explore the use of new technologies, but have IT play a role in establishing guardrails.
- Bridge the gap. IT will still be leaned on to scale and iterate on innovative solutions. Try using technologies like low-code and RPA to bridge the gap between the business and technical sides of your organization during prototyping and design stages. Also, try aligning IT efforts more with business objectives—such as through shared KPIs—to improve productivity and business outcomes.

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Trend 4

Anywhere, Everywhere:

Integrating your virtual workplace

When the pandemic hit in spring of 2020, billions of people around the world changed behavior virtually overnight. Businesses and government agencies alike sent their people to work from home and doubled down on technology solutions to keep them productive. A vast majority of federal executives—79 percent—surveyed by Accenture in early 2021 agreed that their organization's employees had just faced the largest and fastest human behavioral change in history due to COVID-19.

Many organizations approached these changes as short-term solutions to a temporary disruption. But it is increasingly clear that, post-pandemic, no one is going back to work as they remember it. Instead, we are all moving into a new future where work can be done from anywhere.

"Because we've got everything connected, because we've got this workforce that can now work from wherever they are, whenever they want, it's changed the paradigm on how we're going to do work," Air Force Vice Chief of Staff Gen. Stephen Wilson remarked recently.[74]

Forward-looking agencies will seize this future to address persistent challenges and take advantage of the many new opportunities that today's virtual workplace paradigm affords. In other words, it is time to transform remote work from an accommodation to an advantage by rethinking what the organization looks like and what it can achieve with a virtualized workforce model.

How government agencies can prepare for today's "bring your own environment" world

In the early days of the "bring your own device" (BYOD) movement, employers had to fashion new, flexible policies and technology solutions to accommodate a wide spectrum of devices while also mitigating the many information security risks that accompanied this new paradigm. This gave employees a chance to be more productive and have a better work experience. Now we've moved beyond BYOD and into BYOE: Employees are bringing *entire environments* to work.

They may be working on a company laptop, but that laptop is connected to a personal home network that also hosts smart speakers, security cameras, gaming consoles, and more—the average U.S. household already averages 10 connected devices.[75] The laptop itself is sitting on the kitchen island between the day's mail and the kids' homework. And in the middle of all that is the employee—leaning heavily on technology to meet the demands of her job while surrounded by the demands of her life.

Moreover, remote work environments aren't limited to the home. Employees in the post-pandemic era will most likely be working in multiple locations throughout the work week: at home, the office, the airport, an enterprise partners' offices, a field location, or somewhere else. For workers needing to be onsite to support classified programs, there's even a question of how can they bifurcate their work lives so some projects can be completed remotely.

The reality is that BYOE is here to stay. Employees have spent a year experiencing the flexibility and benefits of working from home and elsewhere; many will be reluctant to return to offices. Likewise, many agencies have discovered that large-scale remote work can reduce energy, facility, and commute costs and even boost employee productivity. For some, that will mean going back to the office; for some it will mean going 100 percent remote; and still others will want a mix.

Leading organizations were already moving toward workforce decentralization before the pandemic, eyeing benefits like the ability to recruit from non-traditional locations or offering their people more flexibility and freedom. The demonstrated ability of cloud-based platforms and collaboration tools to fully support remote workers—and the resulting productivity improvements—will only accelerate this trend.

Today's BYOE paradigm will certainly outlast the pandemic, which means organizational leaders will need to reassess the size and purposes of the physical office. In the future, successful organizations will be the ones who resisted the urge to race everyone back to the office in favor of rethinking their workforce model.

> 87% of federal executives (versus 81% of executives globally) agree that leading organizations in their industry will start shifting from a Bring Your Own Device (BYOD) to Bring Your Own Environment (BYOE) workforce approach.

The federal implications of today's BYOE paradigm

Federal agencies have been experimenting with remote work for decades, but until the pandemic occurred, only a few agencies, including the U.S. Patent & Trademark Organization (USPTO), NASA, the General Services Administration (GSA), the Nuclear Regulatory Commission, and the National Science Foundation (NSF), had embraced it on a large scale. Prior to the shutdown, only 55 percent of the 907,813 telework-eligible federal employees were working remotely to any extent, underscoring potential obstacles in doing so.[76]

So what have we learned so far, having more than a year of wide-scale remote work under our belt? And what are the opportunities for government that lie ahead as leaders weigh their next steps?

- **Big, rapid change is doable.** Agencies and their employees discovered they are nimbler than they might have thought. Agencies had to loosen restrictions on where employees can work, equip them with the tools to do so, support them both professionally and personally, and then figure out how to achieve their mission objectives virtually—all in short order.

- **It's time to re-imagine traditional work structures.** It turns out many meetings simply aren't that necessary (imagine that!). What's more, that standard eight-hour shift may not be optimal for everyone and sitting at a desk doesn't always translate into productivity. In fact, many federal leaders found that moving to a remote work model yielded productivity levels that were the same or better than before the pandemic.[77]

- **Long-term success requires stakeholder engagement.** Agency managers will need to engage their many stakeholders, including federal unions, to re-calibrate workplace policies and practices, affecting everything from performance appraisals and job descriptions to interoffice communications and recruiting.

- **BYOE augurs big changes for recruitment.** As more and more positions become remote-enabled, recruiting efforts can be freed up to expand from a local focus to a more national focus, dramatically widening the available labor pool for many positions.

- **Workplace *and* work time are changing.** It's not just the work*place* that's become more fluid with BYOE—it's also the work*day* itself. This means agencies will need to think about how to adjust workplace policies and protocols to fit today's more fluid schedules.

- **Policies need to keep pace.** Existing policies and work rules may unnecessarily inhibit virtual work. For example, many experts contend that too much government information is overclassified; a critical implication of this, besides cost, is the increased difficulty in working virtually with classified information. Also, today's BYOE paradigm is occurring in tandem with another momentous workplace trend changing the nature of federal work: the increasing adoption of artificial intelligence, machine learning, and automation technologies. Amid these transformations, it behooves agency managers to review federal job descriptions to ensure they have the flexibility needed to accommodate current and future changes in how work gets done.

- **More IT modernization is needed.** The technology piece of BYOE needs further refinements to be successful over the long haul. Virtual private networks, telework tools, and training, for example, will need to be re-assessed and upgraded to ensure virtual work is done securely, fluently, seamlessly across organizational boundaries, and with fairness and equity in mind for all employees wherever they work. Paper-based processes will need to be digitized and many IT services and capabilities should be made available as a self-service. Finally, interoperability is key so that collaboration tools can connect federal employees with their inter-agency, intra-agency, and even non-federal colleagues and stakeholders.

- **Employees need more technical training.** Whether it's about having a working fluency with the latest collaboration tools or knowing how to mitigate security risks, employees will have continuing needs for upskilling.

As agency leaders define what their workplaces will look like in the post-pandemic era, it is clear there are many factors they will need to weigh.

> Agencies will need to think about how to adjust workplace policies and protocols to fit today's more fluid schedules.

The stakes for getting it right

As the commercial world moves deliberately into this new era of remote work, government agencies will need to keep pace—not only so they can deliver on their missions, but also so they can recruit and retain the new talent they will need in the future. Workplace flexibility is increasingly an expectation across the job market and federal agencies will need to get this right as they compete to attract and retain talent in the future.

This was clearly one of the driving forces behind the release in early 2021 of a "Future of Work" concept paper by the Army's Combat Capabilities Development Command (DEVCOM), which encourages employees to work where and when they are most productive.[78] "We know people are most productive when they're happy with their life, and for a lot of people that's location based, that's family based, that's geography based," said John Willison, deputy to the commanding general of DEVCOM. "So in a job announcement, I can say, 'Here's the expectation: every so often, you're going to have to come in and work with the team.' And that will be different for different positions, but we now open up our ability to attract and recruit talent to so many different sources that we haven't been able to have before, because we stipulated a duty location."[79]

Similarly, the Securities and Exchange Commission (SEC) introduced remote work options prior to the pandemic to improve retention and protect the substantial training investments it makes in its workforce. In doing so, the SEC found that the more days an employee teleworked, the less likely he or she was to consider leaving the agency within the next year.[80]

Not surprisingly, agencies that offer employees greater flexibility in their day-to-day work environments also typically enjoy greater employee satisfaction and loyalty, as shown in the annual *Best Places to Work in Government* surveys. "By looking at teleworkers within the *Best Places to Work* framework, managers can see how telework positively influences overall job satisfaction," wrote the Partnership for Public Service. "Just having that option available, regardless of whether it is actually used, can have a positive impact on employee satisfaction, and ultimately on job performance."[81]

When executed well, remote work environments can deliver many other benefits as well. Lower energy and real estate costs, fewer employee sick days, reduced commuting for employees, greater resiliency and continuity of operations—all of these are associated with more flexible work environments.

Going forward, the strongest and most resilient organizations will be physically distributed, creatively connected, empowered by technology, and able to innovate from anywhere. While the specific balance will vary by agency and employee, the BYOE model drives real value when smartly deployed.

> **87%** of federal executives believe the remote workforce opens up the market for difficult to find talent and expands the competition for talent among organizations.

Explore further

Fortify:

From patchwork solutions to permanent strategy

The pandemic kicked off fresh new waves of technology investment for many agencies so they could accommodate remote work on a greater scale. In our survey of federal executives, sizable percentages said their organizations invested in digital collaboration tools (47 percent) and cloud-enabled tools and technologies (41 percent) to support their remote workforces during COVID-19. Other investments targeted productivity management tools, remote monitoring technologies, home networking equipment, training, and more.

As agency leaders look to improve upon their BYOE capabilities further, there are four areas of focus that can help: ensuring collaboration tools work well together; upskilling employees where needed; committing to a satisfying employee experience; and getting security right.

- **Collaboration tools.** The tools used by one organization may not interoperate with those of another organization, even within the same agency. Or they may interoperate, but they produce uneven experiences, leading to disparities. "One of the things we have to prepare for is the democratization of access," said Vaughn Noga, chief information officer at the Environmental Protection Agency. "One of the things that we're really focused on is making sure that we don't have a disparity of experience."[82] To address this, the EPA is placing greater focus on fine-tuning its collaboration technologies—updating videoconferencing equipment, beefing up network bandwidth, and emphasizing more training around the technology—so everyone has the same experience, whether working from home or not. Also, there are promising new advances in collaboration tools that agency managers may consider. For example, extended reality platforms can now offer immersive experiences that transport remote workers to virtual environments where they can interact with systems and coworkers in real-time.

- **Upskilling.** As Noga from the EPA said, "It's not always the IT or the technology. It's how you train and support folks who may not be IT folks to use this technology." He added that EPA "spent a lot of time on training to make sure people understand on their terms."[83] As new technologies enter the workplace, it is critical that employees are prepared to benefit from them. Without that training piece, troubling misalignments can emerge between employees and their tools.

- **Employee experience.** When workers were in the office, it was easier to spot problems with the employee experience. With BYOE as the new future, employee experience is more important than ever, but it is obscured behind miles of distance, shifted schedules, and potentially disparate time zones. Analytics tools can be helpful here, but so can simply being more proactive in engaging your staff, talking to them about what they are experiencing, and involving them in the solutioning process.

- **Security.** Agencies need to accept that, in many cases, their employees' environments are a permanent part of their own enterprise attack surface and adjust accordingly. Security was a pain point for enterprises long before the company attack surface expanded to include employees' homes and their connected TVs, speakers, smart home devices, and security cameras. This increased uncertainty is likely to render traditional "moats and castles" perimeter-based security strategies unsustainable. Rather, agencies will want to accelerate their move to zero trust architectures interlaced with automation and intelligent tools to identify potential bad actors hiding in the everyday back and forth.

The payoff is worth the investment. As the Army DEVCOM states in its "Future of Work" concept document: "To maximize our potential and impact, our Command must embrace a future of work environment that is different from the past." By embracing greater flexibility in *where* and *when* work gets done, the command argues it can "shift from reactively filling vacancies to proactively building the talent needed to execute the DEVCOM mission now and in the future."[84] Agency leaders already understand their greatest assets are their people—taking these steps and making these investments will help ensure they attract and keep the people they need to be successful in the future.

Extend:

New workspace, new opportunities

A few pace-setting agencies were trailblazers in BYOE well before the pandemic. A case in point is the U.S. Patent and Trademark Office (USPTO), which demonstrated that significant benefits are possible when organizations thoughtfully push the boundaries of remote work. The agency grew its program over two decades, and by 2019, more than 11,000 employees were teleworking weekly, with more than 7,000 employees relinquishing USPTO workspace to work from home four to five days per week.[85]

By greatly expanding the scale of its remote work program, USPTO was able to completely re-imagine the utility of its office building infrastructure and significantly shrink its real estate footprint. It moved to a hoteling model, called the Patent Hoteling Program, for much of its office space and reaped impressive gains in response. The agency claimed in a 2020 report that it avoids more than $50 million in costs annually by not having to provide office space to employees due to its full-time telework programs.[86]

The benefits of more flexible work were not just in terms of real estate savings. When USPTO began offering patent examiners not just a work-from-home (WFH) option but also a more expansive, work-from-anywhere (WFA) option, in which employees could have the geographic freedom to live wherever they wish, it led to a 4.4 percent increase in productivity.[87]

Other agencies have followed suit. The General Services Administration similarly expanded its remote work program, allowing it to re-imagine its real estate needs and install a hoteling program at its renovated headquarters. This helped reduce real estate and office costs by $24.6 million. Telework helped the Department of Justice save more than $5.5 million in office space, improved productivity, lower absenteeism, lower commuting costs, employee attrition, and more. Likewise, the Homeland Security Department saved about $2.3 million in real estate and desk sharing.[88]

The ramifications of this are truly staggering. Imagine for example, how this might benefit the Defense Department, which not only has enormous real estate holdings, but also spends billions of dollars annually moving personnel from one base to another. "I would see us not going back to some of the models, right?" said Air Force Deputy Chief of Staff for Manpower, Personnel, and Services Lt. Gen. Brian Kelly. "Not just telework in the location where you live, but imagine us now being able to hire somebody in Arizona who works in the Pentagon, and then never leaving Arizona—maybe occasionally coming TDY [temporary duty travel] to the Pentagon, but staying in their home. [And] for certain staff jobs, our military members, not PCSing [permanent change of station] because they're able to effectively telework."[89]

Clearly, the benefits of BYOE are vast. In the long run, embracing BYOE isn't just about accommodating a benefit your people have gotten used to, or even about increasing resilience against future disruptions. It's an opportunity to reimagine what you do and what you can offer to the employees who help you deliver it. The benefits are vast: true national access to talent; having a workforce that's constantly "on" by virtue of coverage across time zones; even delivering on sustainability goals by right-sizing office spaces and cutting down on polluting, energy-consuming employee commutes.

Reinvent:

Embrace the new work culture

There is a big difference between the BYOD movement that swept across many federal agencies a decade ago and today's shift to BYOE. With BYOD, the challenges were primarily limited to tech functionality and security. When we use the word "environment," however, we are talking about people's lives. A person's environment is more than just devices and WiFi networks. It's kids, pets, the construction happening next door, the sick relatives they're supporting, their stress levels—the humanity of the equation. None of these challenges are new for any of us as people, but "going to work" used to provide some separation that kept them largely out of the employer's purview. No more.

The enterprise must accept that the employee environment is now part of the "workplace," and accommodate for people's needs just as they would for people's technical requirements. This will be a large, slow-to-emerge cultural shift, but there are some tips to help you find your footing:

- **Recognize that BYOE is a work in progress.** Commit yourself to continued improvement. We see this, for example, in the way the EPA is upgrading its tools and training to ensure employees are getting a similar level of end user experience.

- **Be careful about divides emerging in your workforce.** In government, there will always be a sizable portion of the workforce that comes to the office each morning. Especially at national security agencies, many employees simply cannot work from home because the classified information they work with is only accessible in secure facilities. Still other employees feel more productive in an office setting and enjoy the in-person camaraderie that offices offer. Workers in different roles will benefit from the best work environment for their needs, but without careful implementation it could lead to a divided workforce where in-office and remote workers struggle to collaborate and become demoralized or feel unsupported.

- **Tend to the disparities.** Take steps to ensure a level playing field for all employees, regardless of where they work. For example, the Government Accountability Office encourages agencies to hold teleworkers and non-teleworkers to the same performance standards. Training programs can help ensure employees and managers are on the same page. And agencies should ensure access and security challenges in their technology offerings are well addressed.[90]

- **Train your managers how to properly manage distributed teams.** They will need to learn how to manage employees based on their results and outcomes, and less on the processes used to produce that work. Setting and measuring goals in distributed teams is different. They will have to trust their employees to do the right thing and make sure their team has the support, information, training, and tools they need to get it done. They will have to learn how to communicate effectively and be comfortable with an indirect line of sight into what employees are doing in their adapted and adopted work environments.

- **Listen to your employees and be proactive in addressing their concerns.** Leaders and managers will need to 'lean in' to their teams to make this work. They will need to handle conflict faster and more directly, so it doesn't fester out of sight. And they will need to spend a different type of quality time with their teams and team members listening deeply and asking appropriate probing questions when seeking to understand a situation or concern. When your workforce is distributed geographically, you can't simply wait for their problems to show up at your doorstep—it may be too late by then. Engage your people and make two-way communications a priority.

Optimizing your organization for a BYOE strategy is a moving target and best practices are still evolving. But one thing is certain: Waiting to act isn't an option. To create an organization that attracts the best talent and keeps employees engaged, enterprises will need to constantly experiment with new solutions, pursuing and supporting cultural changes like these across the organization.

Decision points

Fortify: How is your agency making remote work sustainable, seamless, and secure?

- Identify where you made rapid digital transformations and prioritize addressing outstanding security concerns. Cyberattacks are on the rise and the enterprise's attack surface is wider than ever. Commit the necessary resources to security teams to minimize risk to both the business and employee.
- Re-evaluate technology strategy to ensure benefits of remote work are being maximized. Examine VPN needs and access requirements, ensure employees are trained to use the tools they have, and create a pipeline for employees to recommend new collaborative solutions to the organization.

Extend: How are your people responding to remote work?

- Open the lines of communication with your employees to explore the future of work. What is working for some teams or individuals may not be the same for others. Engage your people to understand what benefits (or challenges) they are facing with remote work, share best practices, and solicit their involvement as you develop strategies and solutions for moving forward.
- Partner with your workforce to understand the new demands they face as their home becomes their office. Uncover accommodations the enterprise can make as the employee's environment—including their personal life—becomes part of the "workplace" and requires different accommodations.
- You are performing a massive workforce experiment—evaluate how it is going. Invest in workplace analytics tools and develop a set of KPIs to build a deeper understanding of how employees are responding to remote work.

Reinvent: How are you thinking about the purpose of place moving forward?

- Where possible, reimagine how your physical space is utilized. Plan for optimizing offices to account for a growing remote contingent, and how the enterprise can transform these spaces. Explore creating extended reality (XR) capabilities and environments that will foster immersive digital collaboration.
- Revise recruiting and talent strategies to take advantage of talent pools outside your typical geographic markets. For example, think about your recruiting process: resume intake; basic requirements; who candidates interview with (and how). These, and more, will need to be reworked to connect with a wider network.
- Emphasize the culture. Ensure that the informal advantages of workplaces are virtualized as well. Team-building efforts and "water cooler" conversations need to find their digital home as the enterprise builds toward a future with a mix of in-person and remote employees.

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Trend 5

From Me to We:

Take the mission further with multiparty systems

Federal agencies have long collaborated with stakeholders and outside partners to achieve specific mission or business outcomes, whether to ensure quality in supply chains, share health records, administer benefits, exchange data, or track funds, just to name a few.

Agencies typically approach these collaborations as the authority, responsible for everything from collecting, managing, and maintaining the necessary data to issuing regulations and policy and enforcing compliance among all stakeholders. Today, however, we are beginning to see this paradigm give way to a new model in which multiparty collaborations achieve their objectives by relying upon an underpinning of mutual trust in shared data and a shared data infrastructure whose immutability and transparency are assured.

The advancing state of blockchain, distributed ledger, distributed database, tokenization, and other similar technologies and capabilities make this pivot possible. But at the core of MPS is the realization that the capabilities of a single agency can only stretch so far—business and mission outcomes that would otherwise be unattainable or attainable only at great expense require the combined capabilities and expertise of multiple organizations working in collaboration on a basis of trust. This trend is occurring in great haste across many commercial sectors, such as banking and finance, supply chain management, healthcare, and real estate, among others. But we also see many federal agencies exploring multiparty system (MPS) approaches and putting them into practice as a way to bring greater efficiency, transparency, accountability, security, interoperability, and confidence to their transactions and processes.

There are countless use cases where federal agencies can employ MPS approaches to deliver significant benefits. But to do so, agency leaders will need to re-examine their traditional practices and approaches.

The power of multiparty systems in an era of epic disruption

At the height of the COVID-19 pandemic, Singapore introduced a blockchain-based medical record system.[91] The "Digital Health Passport" let individuals store medical documents in a secure digital wallet. At a time when monitoring the spread of the virus was crucial, the system allowed the government to easily track the levels of infection and eliminated the need for paper records—all while maintaining individuals' privacy. It also gave people verifiable test results and the hospital discharge papers they needed in order to be cleared for work. In other words, it put a clean and trusted bill of health right at everyone's fingertips—and was used more than 1.5 million times in its first four months alone.

This isn't an isolated story. From contact tracing to frictionless payments, governments and companies around the world have doubled down in exploring and investing in MPS approaches. With the benefit of hindsight, the rapid adoption of multiparty systems isn't all that surprising. COVID-19 made it clear that organizations can't navigate through disruption and uncertainty alone. One of the biggest impacts of the pandemic was how it unveiled global enterprise fragility, leaving companies and government agencies alike cut off from their partners, scrambling for answers, and needing to build new, trustworthy relationships.

75% of federal executives reported their organization faced a moderate to complete supply chain disruption due to COVID-19.

For instance, the pandemic demanded that enterprises develop deeper insight into how people and things were moving, without sacrificing privacy or efficiency—a capability that existing systems were not ready to meet. Across many areas, multiparty systems quickly shifted from ambitious undertakings to desperately needed solutions.

Take, for example, the global airline industry, which has the common goal of resuming airline travel in a safe, controlled, streamlined way as more people get vaccinated against COVID-19. To accomplish this, the International Air Transport Association (IATA), representing almost 300 airlines around the world, launched the IATA Travel Pass, a mobile app that enables travelers to store and manage verified information on their COVID-19 tests and vaccines. Alan Murray Hayden, IATA's head of airport, passenger, and security products, noted that there are two main issues with confirming whether people wanting to fly have been tested or vaccinated: confidence and scalability. "When people do get tested, they turn up with a piece of paper and people don't have confidence in that. And the second point is that agents still need to check these paper documents. And that's what we are really trying to solve with this solution," Hayden said in an interview published in Future Travel Experience.[92]

The IATA Travel Pass, which employs blockchain technology, is a tool for travelers, but—because it relies upon open standards, an important ingredient for MPS interoperability—it also communicates with governments, airlines, test centers, and vaccination providers to get verified information to those who need it in a safe and secure manner. "This is the beauty of the technology we're using; it puts the passenger in complete control of their data. There's no central database and nobody can hack it. The passenger owns their data and they share it with the airline," Hayden said. IATA hopes the new app will help mitigate bottlenecks that may arise once passenger numbers bounce back. "Replacing the paper documents with electronic version[s] and using the verifiable credential will allow airlines to push all of this off airport[s], so passengers arrive completely documented," Hayden added.[93]

The pandemic demanded that enterprises develop deeper insight into how people and things were moving, without sacrificing privacy or efficiency.

Trials with the IATA Travel Pass demonstrates a key value of multiparty systems, which is that each party to the arrangement is responsible for a function for which it is highly qualified, either because it alone possesses authoritative data critical to the MPS functionality or it has needed domain expertise or both. The result is a capability and value that would be very difficult, if not impossible, for one organization to achieve on its own.

For example, an individual passenger with the Travel Pass app would scan the chip on their passport to retrieve passport information, enter their flight information, and be provided a list of nearby verified lab centers where they can get a COVID test. Those test results are then uploaded to the app by the lab. IATA's Timatic database and rules engine then automatically correlates that information with the COVID travel restrictions in place at the traveler's destination and verifies whether that passenger is authorized to travel. That verification can then be presented to the airline upon arrival at the airport. Each participating party—the passenger, the passport, the lab, IATA, and the airline carrying the passenger—engages in an interoperable, decentralized trust framework that revolves around a secure data foundation.

In the post-COVID era, government and commercial enterprises face an imperative to forge a resilient, adaptable, and trustworthy foundation for their existing and future partnerships. There's opportunity here: Disruption has upended our expectations for ecosystems and ambitious enterprises are creating new standards for industry. Coordinated, strategic ecosystem partnerships will set government agencies and companies up to address today's disruptions and be better prepared to weather new ones, but they'll also enable ways to create new interactions and tackle complex problems.

Multiparty systems: Combining trust and collaboration to reformulate federal operations

It takes a lot of time, energy, and resources to manage something as complex as, say, a supply chain for electronic components for military weapons systems.

It requires dedicated staff, IT resources, and budgets. The data at the center of it must be continuously updated, reconciled, backed up, and verified. Even then, it can be hard to trust the data due to gaps, irregularities, human error, or even outright tampering. Visibility into that data can also be challenging—stakeholders may have to synchronize their data to make sure they are all tracking accurate, up-to-date information.

Multiparty systems offer federal agencies a way to achieve business and mission outcomes that would otherwise be unattainable or attainable only through great expense in staff, budget, and time resources. While the benefits of MPS arrangements can be significant, it's important to understand that they begin with the core understanding that those benefits are attainable only by pooling the resources and contributions of many organizations.

Take, for example, the Defense Logistics Agency, which has a need to counter the threat of counterfeit and nonconforming parts entering the Defense Department's supply chain. For this purpose, DLA created the Counterfeit Detection & Avoidance Program (CDAP), which aims to ensure that critical electronic components are procured from reputable vendors and manufacturers. To do this, the program relies upon a pre-qualification of vendors and a post-award review process to inform decisions about whether components are safe to procure. These processes are highly manual and require a great deal of correspondence with vendors.

In 2019, DLA saw the potential to achieve these same goals using digital processes that would deliver greater automation, efficiency, and anti-fraud protections. But to do this, DLA leaders realized they needed to start by assembling a larger ecosystem of organizations that have a mutual stake in the outcome and obtain their participation. A diverse stakeholder group was formed that included CDAP representatives; DLA's warehousing team in Warren, Ohio; a test laboratory team responsible for inspecting electronic microcircuits received through the CDAP process; original equipment manufacturers (OEMs) and original component manufacturers (OCMs); and distributors and resellers. Together, these organizations formed a Trusted Working Group, which drafted a vision for an improved, more efficient method of collaborating to complete CDAP requirements.[94]

As with the DLA example, any MPS arrangement begins first with a focus on thinking outside of one's organizational boundaries for solutions to thorny, complex challenges. It's about asking, "where do I fit in the ecosystem of my mission outcomes, where do I contribute to other organizations' mission outcomes, and how do I form those partnerships to get needed efficiencies to deliver better value to my constituents?" It is these partnerships and assembled ecosystems that will allow agencies to make challenging business and mission outcomes more easily and quickly attainable with less expense. But there are other key benefits that come from MPS approaches as well:

- They institutionalize trust in their data and processes, presenting all parties involved a single source of truth; and
- They spread the burden of collecting, validating, storing, managing, adjudicating, and maintaining all the data required to manage a complex process.

There are myriad other benefits as well, depending on the use case involved. For supply chain traceability, for example, it dramatically accelerates the time—from several days down to a few seconds—to identify an impacted product, whether tainted lettuce or a recalled drug, and alert downstream partners.[95] For supply chain integrity, it improves safety and security.[96] For grants management, benefits include greater transparency, reduced financial burden, and improved customer experience.[97]

MPSs accomplish all this by enabling federal agencies to shift their approach from *managing the complex process* by themselves to *orchestrating an ecosystem* that manages the process together as a shared, trusted, transparent undertaking. Put simply, MPS helps us trust the data we rely on and trust the transactions we conduct without having to centralize it all into one big system that we manage ourselves.

The appeal is pretty clear: Orchestrating an ecosystem—especially when using automation and artificial intelligence—takes a lot less time, energy, and resources than managing the whole process and all of the underlying systems and data. For example, DLA ultimately designed and implemented a prototype application, called Blockchain Traceability for the Counterfeit Detection and Avoidance, that enabled CDAP and its vendors to collaborate closely on the same platform. The application included several novel features, including: a near real-time credential verification button; immutable records of vendor qualifications and related documentation; and a process for onboarding vendors with a blockchain-based decentralized identifier. These features, along with several other quality of life improvements such as automated email services, field-level validations, and help text provided the CDAP stakeholders with a greatly enhanced digital process compared to the current state.[98]

As with all MPS arrangements, once all of the participating parties contribute their respective domain expertise and data, much of which is done automatically, the MPS uses data analytics to automate the intended outcomes. Those outcomes could include spotting an anomalous component in a supply chain, streamlining an administrative process, or verifying someone's eligibility for benefits. Moreover, the result is more trustworthy, transparent, and accountable than with traditional approaches.

Those features—trust, transparency, accountability—are a byproduct of the technology underlying any MPS. These technologies include distributed databases, distributed ledgers, and digital tokens. Of these, blockchain—a type of distributed ledger technology—is by far the most widely used. While there are many varieties of blockchain, it is, at its core, an immutable and encrypted ledger system that is distributed across a decentralized network of independent computers which can update in near real time. The beauty of a distributed ledger system is that it allows any participating user to prove the record is uncorrupted. Think of it as a strongly encrypted, verified, shared Google Document in which data can be added but never changed and in which each entry depends on a logical relationship to all preceding entries and is agreed upon by everyone who has access to it.

Because it operates as a shared, synchronized and geographically disbursed database with no centralized data storage, the system is designed to remove the "single point of failure" risk present in many other systems. Plus, blockchain is intrinsically a highly secure architecture. Each data entry creates one block within a chain of blocks, and each block is hashed by a set of unique characters derived from information contained inside that block. Every block of data added to the chain has its own unique hash. If any unauthorized changes to the data are made, it becomes immediately apparent to all participating parties.

Many federal experts see tremendous promise in blockchain and other MPS technologies as a tool to advance government business and mission needs. "Data sharing through a blockchain can increase trust in detailed accounts, improve seamless communication, reduce data variation and mitigate friction points when information transfer needs to be timely and actionable," wrote Brig. Gen. Mark Simerly, commander of the Defense Logistics Agency Troop Support in Philadelphia, and Dan Keenaghan, then-process compliance director for audit and process improvement at DLA Troop Support, Philadelphia, in an article about the value of blockchain in military logistics.[99]

In broad terms, MPS arrangements excel at tracking assets, exchanging data, and automating processes. Consequently, we see them in practice most frequently with use cases that involve many federal tasks and functions: accounting, auditing, data provenance, supply chain management, finance, titling, Internet of Things (IoT) management, and digital identity, among others.

> 18% of federal executives report their organizations are scaling their multiparty systems this year with another 15% beginning to experiment.

Many agencies are already exploring multiparty systems

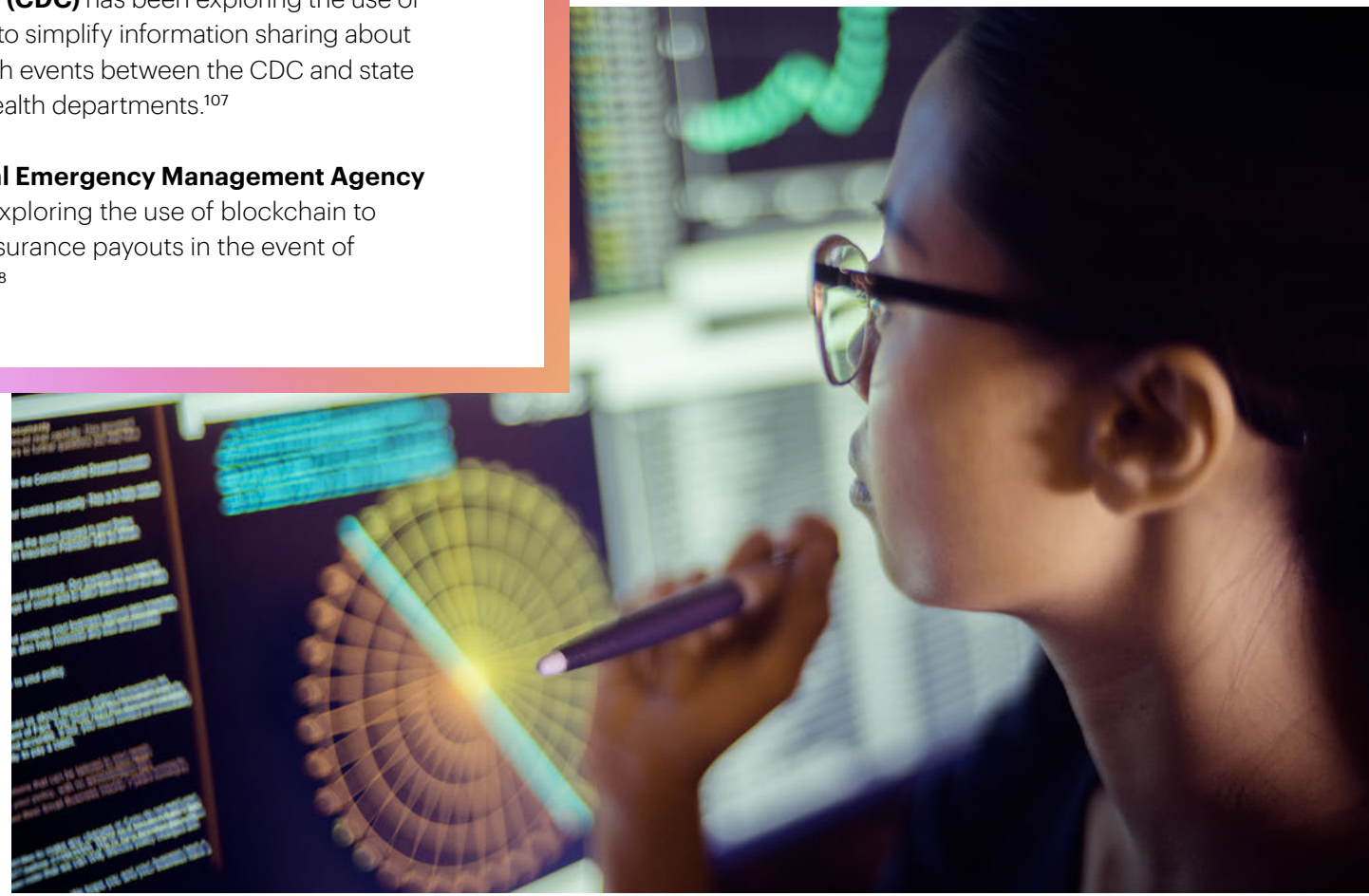
Given the many benefits of MPS approaches, it's easy to see why so many organizations are exploring their use in addressing a wide array of complex challenges. For example, Customs and Border Protection (CBP) conducted a successful proof-of-concept to demonstrate blockchain's ability to help border agents rapidly and cost-effectively determine whether imported products are infringing on the intellectual property rights (IPR) of American companies.[100] The proof-of-concept showed that blockchain connected product data correctly to the product and to the product license, resulting in fewer physical examinations of products being imported, according to CBP. Seven companies participated in the test and were able to communicate with other participants using their unique blockchain, regardless of different software used by each party, due to the program's open global standards and approaches. This demonstration may offer new tools in CBP's fight against imported counterfeit goods.

Similarly, the Treasury Department has been working since 2017 on a project to test how blockchain can improve the grants payment process. Treasury has been working with the National Science Foundation, which has a large research grant portfolio, San Diego State University, and Duke University. In this project, Treasury creates a digital asset (or *token*) that is embedded in a blockchain that contains the details and payments found in letters of credit that are sent to grantees. So rather than having to rely on regular reporting from the prime and sub-grantee recipients, NSF can use the blockchain to track the grant payments and ensure that the terms of the grant are being followed and that the whole transaction is more secure. This frees up grantees of some of their reporting requirements.[101]

The Health and Human Services Department pioneered the federal government's first use of blockchain in 2018 when it received an authority to operate a blockchain- and AI-powered tool called HHS Accelerate. The tool uses blockchain to link together and affirm the integrity of current data from multiple contract-writing systems and about 100,000 contracts that represent nearly $25 billion in annual spend and updates that data every 24 hours. The tool's purpose is to create full visibility into the prices the department pays vendors for products and services so it has greater negotiating power to reduce its procurement spend. Pulling together and analyzing the data needed to negotiate a department-wide strategic sourcing procurement used to take months of work—with Accelerate, it takes seconds.[102] By 2020, the Accelerate tool had saved the department an estimated $30 million over five years with just one large procurement and more savings were anticipated with other large procurement deals in the works.[103]

These are just a few examples. But many other agencies are also incorporating blockchain and other MPS technologies for various use cases. To list a few:

- **The U.S. Air Force** is testing blockchain's ability to secure industrial IoT networks from unauthorized tampering or cyber attacks.[104]
- **CBP** is exploring whether blockchain can ensure that the data coming from cameras and sensors posted along the border has not been spoofed or tampered with in any way.[105]
- **The Naval Air Warfare Center** in San Diego is deploying a blockchain-based messaging and transaction platform that will be used to share technical and provenance information between stakeholders—whether on land, at sea, or air-based—in a trusted and secure environment.[106]
- **The Centers for Disease Control and Prevention (CDC)** has been exploring the use of blockchain to simplify information sharing about public health events between the CDC and state and local health departments.[107]
- **The Federal Emergency Management Agency (FEMA)** is exploring the use of blockchain to expedite insurance payouts in the event of a disaster.[108]



Explore further

Fortify:

When clouds collide

Rapid digitalization during the pandemic has paved the way for enterprises to rethink partnerships. The intrinsic capabilities of the cloud—the scale, the API-enabled connectedness, the advanced cloud-native applications—have long been gateways to deep collaboration, and now that enterprises of all stripes have accelerated their cloud transformations all at once, there is an abundance of potential partners.

Simultaneous and accelerated change is creating a network effect that will lead to new services, business models, and value generation. As organizations interconnect their cloud assets in exciting new ways, new partnerships will be forged and traditional boundaries challenged. The most immediate step federal agencies need to take is to make sure they have the foundation needed to participate in and lead the new digital ecosystems that are already emerging.

A good example of this can be found at the Homeland Security Department. The department's first blockchain proof-of-concept (POC) was conducted in 2018 by CBP, which tested whether the technology could assist border agents as they process imported goods subject to the North American Free Trade Agreement (NAFTA) and Central America Free Trade Agreement (CAFTA). The POC was a joint effort that also had significant participation from importers, CBP auditors, import and entry specialists, CBP legal and policy personnel, technology companies, and suppliers. The POC proved 100 percent successful, demonstrating that blockchain technology can be implemented in a U.S. customs environment, improve the processing and tracking of trade documents, facilitate interaction with multiple entities, enable better auditability, reduce paperwork, and expedite processing.[109]

But that success—and the success of numerous other MPS proof of concepts to follow—owes itself to DHS laying the needed groundwork with a capable, flexible cloud foundation; open, pre-defined standards for easier integration; and needed in-house and contracted technical expertise. "Historically, when new technologies or solutions are incorporated into legacy systems, there are obstacles that create slowdowns as workarounds are developed so that the systems mesh properly," said Anil John, technical director at DHS' Silicon Valley Innovation Program, which is part of the department's Science and Technology Directorate (S&T). "However, through the use of globally acceptable and implemented specifications and standards, we are addressing and removing those interoperability hurdles before deployment. That way our industry partners and government components can hit the ground running."[110]

That spadework was critical because the integration challenge to make the POC possible was considerable: The resulting blockchain integrated with 10 different systems and three different types of blockchain software. In addition, trading partners participating in the POC relied upon different operational environments—some ran their systems on Amazon Web Services, others in the IBM Cloud, others in custom Docker environments, and still others in Open Stack environments. Engineers with DHS' Digital Bazaar worked through these challenges and achieved interoperability using HTTP API connections.[111]

After CBP's successful demonstration, S&T helped the U.S. Citizenship and Immigration Services test blockchain's ability to improve the way it issues citizenship, immigration, and employment work-status authorization documents to be faster, more accurate, and more secure. It also helped the Transportation Security Administration explore whether blockchain could help secure, automate, and speed up the credential validation process at checkpoints.[112]

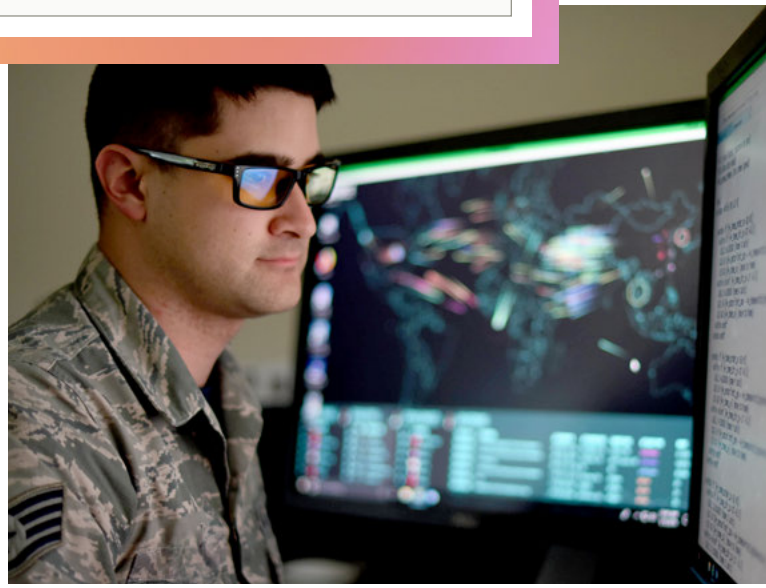
In general, commercial sectors are outpacing federal adoption of MPS technologies such as blockchain—but not in every case. CBP noted in its after-action report following the POC that many trading companies had not yet adopted blockchain, which "may prevent rapid adoption `of this technology."[113] But this relative immaturity of the marketplace presents federal agencies with a golden opportunity. "If government entities join the blockchain revolution early on, they have an opportunity to drive the change, rather than to react and adapt to systems established by others," wrote Svetlana Angert in her 2019 thesis examining the lessons learned of the CBP proof of concept while at the Naval Postgraduate School in Monterey, Calif. She noted that DHS' early effort to set the interoperability specifications and standards for blockchain was critical to success, and she urged other agencies to take the initiative in doing this as well. "CBP can facilitate future coordination, implementation, and creation of global blockchain standards necessary in international trade," she wrote.[114]

As the DHS example demonstrates, the cloud is fundamental to unlocking the power of MPS. In addition to the growing number of blockchain platforms emerging in the marketplace, many of the larger federal cloud services, including AWS, Microsoft, and Google, offer blockchain services. Also, many of the major enterprise resource planning (ERP) vendors have begun adding blockchain capabilities to their offerings.

The Defense Department's Defense Information Systems Agency (DISA) is going even further by creating a Blockchain-as-a-Service (BlaaS) offering that can be used by DoD support agencies and military services to streamline the path to production for blockchain systems in the future.[115]

As partners combine their digital efforts, the resulting ecosystems are generating novel solutions, just as we saw with CBP's free trade agreement blockchain demonstration. Successful leaders are adopting an ecosystem mindset that feeds through business and technology strategy, eschewing the traditional organizational boundaries of the past. MPS makes clear that technology-based ecosystems are the foundation for future growth and leadership, and agencies will need to invest in the needed platforms to set those ecosystems motion.

91% of federal executives agree that to be agile and resilient, their organizations need to fast forward their digital transformation with cloud at its core.



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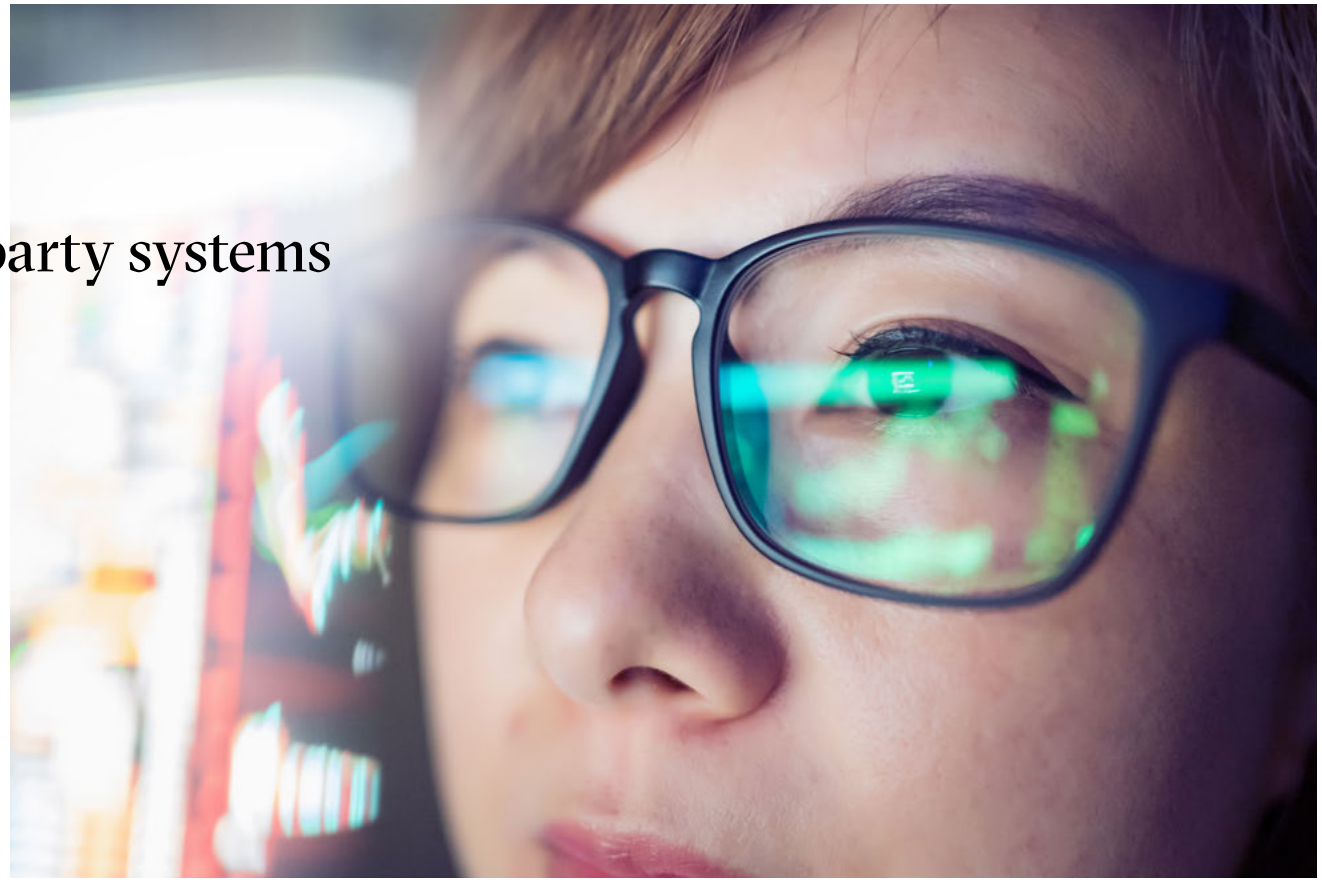
Extend:

Natural federal use cases for multiparty systems

Having a cloud foundation is key to benefiting from the value of MPS approaches, but so is the need to shift one's thinking to better envision the vast possibilities MPS can bring to federal mission and business operations.

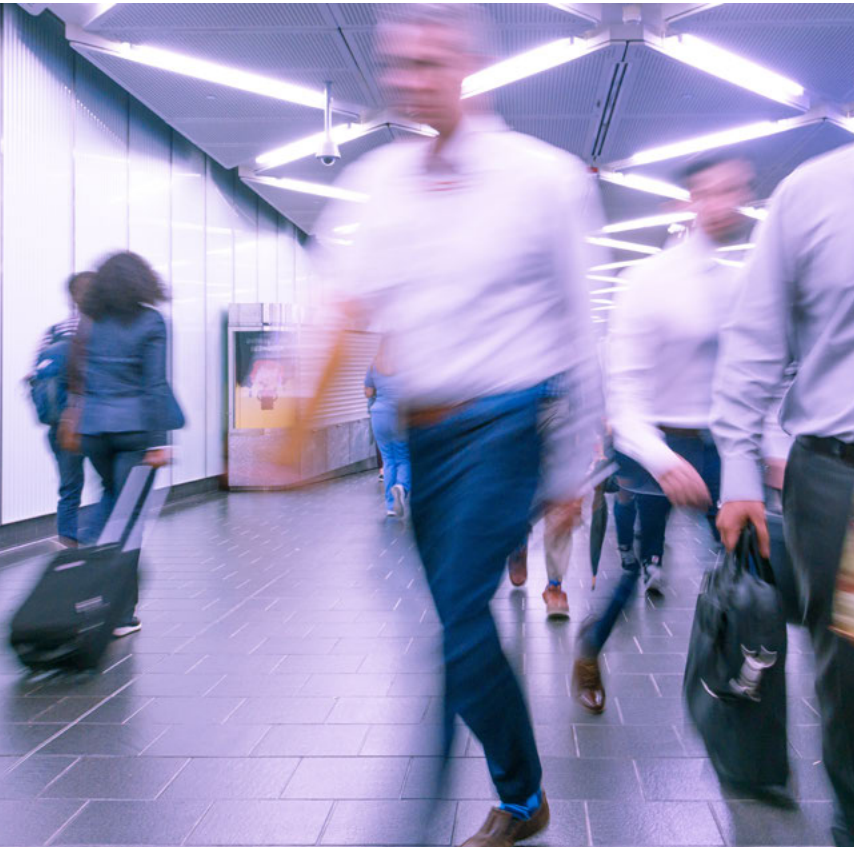


Again, DHS offers a good example here. Technologists there had been tracking the progress of distributed ledger technology for years and saw significant promise in its applications for many DHS business and mission operations. "Throughout the HSE [Homeland Security Enterprise], agencies issue entitlements, attestations and certifications," said a July 2019 press release issued by the department's Science and Technology Directorate. "The holders of those credentials might be an individual, organization or product, but from the HSE perspective, they all have at least one thing in common—the documentation must be quickly verified, extremely robust and resistant to tampering. Paper-based, manual verification solutions are slow, non-centralized and pose [a] greater risk of forgery and counterfeiting. Blockchain is tailor-made to address and mitigate these security and speed issues."[116] It was this insight that drove the department to launch a string of proof of concepts with blockchain.

Perhaps the broadest category of MPS use cases can be found where federal agencies are already engaged in collaborations, networks, and consortiums, either with external organizations or other agencies or both. These can include ecosystems that revolve around supply chains and logistics, financial services, disaster response and assistance, industry regulation and inspection, transportation, research and development, and more. Numerous agencies are already exploring whether MPS arrangements can help them prevent counterfeit components in supply chains, secure military communications, accelerate recalls of tainted food and pharmaceuticals, and dispense disaster assistance more rapidly.[117]

"More than 62 million power grid items were provided to Puerto Rico in the wake of the Category 5 Hurricane Maria," said DLA's Simerly and Keenaghan of DLA Troop Support in Philadelphia in their October – December 2019 issue of *Army Sustainment*. DLA supports FEMA and the U.S. Army Corps of Engineers by leveraging hundreds of contracts to mobilize millions of equipment pieces that support humanitarian assistance and disaster relief efforts. "Although the mission was a success, an assessment of the end-to-end processes uncovered multiple delays, miscommunications, excessive travel costs, a lack of comprehensive end-to-end visibility, and many wasted hours for manual corrections. Research suggested the possibilities for adaptation and innovation through blockchain could increase effective communication of requirements, planning movement and flexibility, monitoring third party delivery and in-transit visibility timelines, compliance with regulatory demands, and transparency for audit. Cost reductions are anticipated in regards [to] information lags, duplication, personnel, movement times, storage, and inventory losses. These efficiencies enabled through blockchain technology would provide real, measurable savings and increase the efficacy of life-saving and recovery efforts."[118]

Another example of how MPS approaches fit naturally into many existing ecosystems can be found in the world of unmanned aerial systems, or UASs. The commercialization of UASes is exploding—there are already nearly four times as many UAS as registered manned aircraft. And many federal agencies, along with the fast-growing UAS industry, are aggressively exploring how blockchain and other MPS technologies can address the many challenges being anticipated with the rapid growth in commercial UAS operations.



According to a 2020 Department of Transportation report, companies and federal agencies are considering embedding blockchain and other distributed ledger technologies into a wide assortment of UAS functions and activities to make them secure, transparent, trackable, authenticated, and trusted. These include identity management, traffic management, conflict management, flight authorization, flight data recorders, insurance, regulation compliance, fleet security, and cybersecurity.[119] "Blockchain is poised to transform the way we think about and analyze safety data," said Regina Houston, Chief of the Aviation Safety Management Systems Division, U.S. DOT Volpe National Transportation Systems Center. "This is particularly exciting for unmanned aerial vehicles. Blockchain can be part of the solution to collecting and sharing reliable data about drones. When you combine machine learning with the data blockchain can provide on UAS registration, accountability, and tracking, an entire world becomes available for drone safety analysis, decision making, and even regulation."[120]

In short, areas where policy, regulatory, and governance frameworks cross over federal organizations and commercial industries are prime venues for MPS applications. A big part of getting MPS off the ground is having disparate organizations agree upon a governance framework on how things will operate; but, in many cases, those already exist in many federal environments, which gives federal agencies a distinct advantage in getting started, finding common ground, and bringing those ecosystems together.

91% of federal executives say multiparty systems will enable their ecosystems to forge a more resilient and adaptable foundation to create new value with their organization's partners.

Reinvent:

A new perspective on value

It helps when enterprises embarking on MPS undertakings have a fuller sense of the value that partnership can bring. Consider an area where MPS is having extraordinary impact: money.

The first large-scale popular implementation of an MPS technology was Bitcoin in 2009. A decentralized digital currency that is not controlled by a central bank, Bitcoin can be exchanged from one user to another through a peer-to-peer network without the need for intermediaries. Bitcoin transactions are verified by network nodes through cryptography and recorded in a blockchain. Its success has touched off a wave of similar cryptocurrencies, all built on decentralized peer-to-peer networks—today, there are more than 4,000 cryptocurrencies in existence, including Ethereum, Litecoin, Cardano, Polkadot, Bitcoin Cash, and Stellar, to name a few.[121] While many of them have little to no following or trading volume, some are immensely popular among dedicated user communities and investors.

This brave new world of cryptocurrencies is prompting many federal agencies to study the potential ramifications they may have on their missions and business operations. For example, numerous federal investigative organizations—including the Treasury Department's Office of Global Targeting, the IRS Criminal Investigation (IRS-CI), the Postal Inspection Service, and the Army Criminal Investigation Command—are reviewing their procedures and exploring solutions that can help them track digital currency transactions that involve individuals, entities, and organizations that are blocked from conducting business with Americans or that are potentially criminal in nature.[122]

In addition, the Energy Department is looking for ways to detect hidden malware that enlists infected computers to mine for digital currencies. Bitcoin mining is the process by which new bitcoins are entered into circulation, and it requires very sophisticated computers that can solve highly complex math problems. If successful, mining can reap cryptocurrency tokens without having to pay for them. Cryptocurrency mining malware is a growing problem for the department's National Labs, which use High-Performance Computing (HPC) applications to conduct complex research.[123]

But the flood of new cryptocurrencies has also catalyzed many governments and central banks around the world to think anew about the need to update their government-backed currencies for the digital age. As of January 2021, 86 percent of the world's central banks were considering issuing "Central Bank Digital Currencies" (CBDCs), according to a report by the Bank of International Settlements (BIS).[124] A CBDC is a digital form of a country's fiat currency; instead of printing money, the central bank issues electronic coins or accounts backed by the full faith and credit of the government. Because CBDCs are the liability of the central bank, the government must maintain reserves and deposits to back it up.

CBDCs are attractive to central banks for many reasons. First, being digital, the maintenance and handling expenses of CBDCs—printing, managing, and transferring, for example—are far less than for hard currencies. Also, people can have access to money on their smart phones, making it more accessible and safer. And because there is a digital track record for every unit of currency, there is greater transparency and more checks on illicit activity.[125] But there are risks as well: our regulatory processes, financial transaction systems, and payment systems are not updated to deal with these new forms of money. Also, the proliferation of digital currencies could hamper the ability of policymakers to track cross-border monetary flows, presenting challenges concerning the use of sanctions and economic policy tools.

In October 2020, the International Monetary Fund (IMF) began working with the Group of 20 to establish a set of standards for CBDCs.[126] Accenture has been working with central banks across the globe as they explore their digital programs and it is likely we will see the first CBDCs come to fruition in the next 12 to 24 months.[127] For instance, The Digital Dollar Project—a non-profit partnership between Accenture and the Digital Dollar Foundation—is advancing a collaborative framework for developing a CBDC in the United States, and the central bank in Sweden, the Riksbank, is piloting the e-krona to test its viability.[128] The project will launch at least five pilot programs over the next 12 months with interested stakeholders and DDP participants to measure the value of and inform the future design of a U.S. CBDC, or "digital dollar."

CBDC efforts worldwide demonstrate why businesses need to have multiparty systems at the forefront of their innovation agenda—and also why leaders need to take a considered approach with their efforts. People are at the center of these ecosystems, and the technology needs to support their ambitions—not overshadow them. Recognizing this, the World Economic Forum, along with Accenture, established a set of guidelines called the Presidio Principles to help guide experimentation with multiparty systems.[129] The guidelines span four categories and include the principles that every participant should have rights to information about the system; that individuals should be able to own and manage their data, and have their data protected in accordance with recognized technical security standards; and that participants should have the information they need in order to pursue effective recourse. The goal of these principles is to ensure that multiparty systems are providing for a more equitable and inclusive future.

At their zenith, MPSs will transform the world. If you've hesitated to explore a full ecosystem approach, now is the time to recognize the opportunity; if you've already been exploring, it's time to move beyond small-scale implementation and become a leading partner in shaping tomorrow's government operations.

Decision points

Fortify: How are digitally led partnerships driving value for your enterprise?

- 2020 saw a surge of federal agencies expanding their embrace of digital platforms to accelerate business and mission operations. Review what platforms your agency—and its stakeholders—leaned on most in the last year.
- Take advantage of cloud solutions and have a strategy for using these solutions to enhance ecosystem collaboration. Find other agency, industry, commercial, and academic partners that have shared interests that overlap with your mission or business and explore collaborating to bring greater value and security to your operations.

Extend: Is your agency ready to participate in multiparty systems?

- Multiparty systems are steadily growing in adoption. Designate a team to scan prominent MPSs emerging in your mission or business area, assess their current and long-term impacts, and gauge your enterprise's relative preparedness to engage them. Make understanding the technology, identifying technical partners and providers, and addressing skills gaps a priority.
- MPS is more than technology—it reshapes business practices and models. Determine if MPS is the right solution by evaluating the business case that will drive your participation. This could include areas where transactional data has yet to be digitized or complex networks that would benefit from a common and trusted platform.

Reinvent: Which business relationships will be transformed by the growth of multiparty systems?

- Think beyond the walls of the enterprise. Interview strategic partners to understand their exposure to multiparty systems. Consider running strategic foresight exercises with these partners to evaluate the need and impact of a multiparty system.
- Consider joining industry consortiums or establishing a working group of inter-enterprise partners. Create the process for assessing the value of any MPS strategy against the benefit to all participants, not just the enterprise in isolation.

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Armed Forces Technology Lead
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Exploring Tech Vision

For over twenty years, the Accenture Technology Vision has identified the most important emerging technology trends impacting businesses, governments, and society over the next three years. What sets it apart is its focus on the underlying forces behind each trend as well as the frank advice it offers on how enterprises should respond. The Accenture Technology Vision is produced by Accenture Labs and Accenture Research with input from over one hundred Accenture leaders and more than two dozen external experts. It also incorporates the findings of a global survey of over 6,000 enterprise leaders.

This year's global report, Leaders Wanted, examines how the world responded to the unprecedented stresses and challenges created by the COVID-19 pandemic. What we learned is that many enterprises are far more agile than they thought. Their challenge going forward is accelerating their digital transformation to meet the new expectations left in the pandemic's wake.

The Accenture Federal Technology Vision 2021 applies these trends to the unique demands and challenges facing the U.S. federal government.

It builds upon insight from more than 50 Accenture Federal Services experts as well as survey data from two hundred federal program, business and IT leaders.

Readers can assess the accuracy and relevancy of our predictions for the federal government by reviewing last year's report. Key trends in the Accenture Federal Technology Vision 2020 included the I in Experience, AI and Me, the Dilemma of Smart Things, Robots in the Wild, and Innovation DNA.

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