



# ENSURING THE EFFECTIVENESS OF FEDERAL CHIEF TECHNOLOGY OFFICERS

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**PSC** PROFESSIONAL  
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# INTRODUCTION

Today, more than ever, federal agencies must create and foster an environment of technology innovation and rapid adoption of commercial best practices. Consistently, agency leaders cite speed and innovation as top priorities, and yet many federal agencies still lament a lack of access to innovative ideas and new technologies. In part to address this concern, many agencies have established a Chief Technology Officer (CTO) position. However, unlike Chief Information Officers, the position of CTO has neither a statutory basis, nor a well-defined set of authorities and responsibilities, leading to a wide variation in the roles, responsibilities and organizational placement of CTOs within and across federal agencies. Nonetheless, even without the requisite structures, a number of federal CTOs are making significant strides to implement new technologies within their agencies. By better articulating the focus and authorities of CTOs, agencies will help speed the successful adoption of new technologies and deliver more effective mission results.

The Professional Services Council (PSC) conducted this study to gain a better understanding on the roles, responsibilities and organizational placement of federal agency CTOs, with a particular focus on their role in innovation and new technology adoption. As a part of the study effort, research and interviews with current and former CTOs were conducted. The report summarizes the findings from this work as well as providing specific recommendations, drawing both from the opinions of the interviewed CTOs and industry subject matter experts who contributed to this study, on how the position of agency CTO should be structured going forward. Included in this second point is an analysis of whether new legislation, following in the footsteps of the Federal Information Technology Acquisition Reform Act (FITARA), would be beneficial or an impediment to empowering CTOs.

Results of this study should not be taken as a unified perspective of the CTO community, as a variety of opinions were offered. Instead, these results serve both to illustrate the broad range in current CTO responsibilities and to offer PSC's recommendations on empowering CTOs to drive innovation and business results.

For this report, the stand-alone term "CTO" will refer to department or agency CTOs. References to industry CTOs or the Chief Technology Officer of the United State (U.S. CTO) will be specifically noted.

# CURRENT RANGE OF CTO ROLES AND RESPONSIBILITIES

Today, the roles and responsibilities of CTOs vary greatly across agencies. While this is in part due to the vast differences in the mission and structure of agencies, it also reflects a range of views within the agencies on the primary purpose of having a CTO. In general, the current work of agency CTOs can be categorized in six broad areas.

## 1. INNOVATION

The most ubiquitous role and responsibility discussed in interviews with current CTOs is the imperative to bring external innovation into their agencies. While some innovation work is process-related, by and large, the bulk of current CTO efforts are around the adoption of new technologies. As one respondent said, their primary function is to “locate innovation outside the agency, bring it in, validate it, and then spread it.” Another respondent noted

that their role is focused on testing new technology or approaches before the agency makes a substantial investment, noting, “It is my job to expand and pilot ideas, not to build solutions.”

The innovation pursued by CTOs is often drawn from industry, but also comes from academia and other federal agencies, state and local governments, and international governments. Many CTOs describe themselves as “innovative change agents.” Most CTOs are focused primarily on adopting innovative mission technology, but

some are concerned exclusively with business and support systems. Of note, not all of the innovation that CTOs are seeking would be described as cutting edge technology. Instead, many CTOs are focused on bringing mature and proven technology and approaches into their agency in an attempt to catch up with the technology already adopted by industry or other agencies.

Further, respondents noted that many agency technology-related challenges are not actually technical problems, but rather cultural or bureaucratic hurdles that stymie the adoption of new technology and process improvements. Many respondents see combating these cultural change challenges as more important than the actual technological challenges.

The rationale for pursuing innovation varies greatly, including creating efficiencies, reducing the costs of operations, reducing the costs of mission execution, improving security, and more. One CTO highlighted that innovations need not be revolutionary or large to be impactful. “Not every change needs to be a major acquisition or an 18-month study. There have been modest but impactful improvements [through rapid actions] such as cloud adoption.”

## 2. MANAGING ENTERPRISE ARCHITECTURE AND DATA

Several CTOs focus extensively on coordinating and standardizing architecture and data usage within their agency, including integrating diverse data systems and building visualization tools and dashboards. As one CTO remarked, their job is “not to do actual

### CTOs BY THE NUMBERS

**2/3 of the 23 CFO Act Federal Agencies have a Chief Technology Officer**

innovation, but instead to do the hard changes that will make a difference over the long haul.” This coordination and standardization work more often focuses on mission technology rather than back office IT. Often this work entails coordinating the work of subordinate offices and bureaus. In some ways, this role overlaps with that of a Chief Data Officer (CDO), if one exists at an agency; in fact, one CTO suggested combining the roles of CTO and CDO into the CTO function.

### 3. COORDINATION BETWEEN OFFICES

Several CTOs are responsible for facilitating technology-related communication and collaboration among the various agencies, bureaus and offices within their organization. This includes information sharing, community building, removing stovepipes, promoting collaboration, and broadly “bringing it all together.” This role is especially pronounced in highly federated agencies. Coordination efforts often focus on standardizing and sharing data collected by subordinate offices and bureaus. Many agencies collect huge amounts of disparate data, and it is often the responsibility of the CTO to facilitate this data being standardized and accessible across the agency. Some CTOs believe that they have a role as an “honest broker” and a responsibility to facilitate a “safe environment for break-through ideas to be effectively shared” by enabling everyone within the agency to have a voice.

### 4. TECHNOLOGY ADVISOR AND CONSULTANT

Several CTOs perform an advisory and oversight role, including significant participation in both acquisition and budget formulation (particularly concerning IT and RDT&E funding.) One respondent noted that it is essential that CTOs possess real authority to affect the agency’s use of technology, including the all-important “go/no go” approval on major technology decisions, and that CTOs should not be limited to a mere “advisory” role.


Some CTOs report having a direct role in major acquisitions. This includes responsibility to review acquisitions to ensure they are consistent with standards and architecture guidelines and to provide formal input on requirements, risk, reliability and scalability. Some CTOs are a part of their agency’s formal acquisition review process, and have actual authority to stop or change acquisitions. One CTO mentioned the concern that, due to a recent reorganization within that agency’s acquisition structure, the CTO no longer has an active role in technology acquisitions.

## HAIL TO THE CHIEFS

**Many Federal Agencies have a plethora of “chiefs” with a hand in the technology business ...**

**Here’s a lineup:**

- CIO – Chief Information Officer**
- CTO – Chief Technology Officer**
- CISO – Chief Information Security Officer**
- CDO – Chief Data Officer**
- CAO – Chief Acquisition Officer**
- CMO – Chief Management Officer**
- CPO – Chief Performance Officer**



**The government's human capital challenges in the technology field are continuing to increase, with a 10:1 ratio of IT professionals over 50 years old versus those under 30 years old. The number of federal workers in their 50's and 60's is increasing, while the number of younger workers declines. It is imperative that federal agencies develop comprehensive strategies to attract and retain the technology workforce for the future.**

Some CTOs are also the primary technology advisor to the head of their agency. While sometimes lacking direct authority, these advisors are tasked with providing an independent view on technology issues to the agency head, similar to how the General Counsel provides independent legal advice.

However, some CTOs are tasked with focusing on a narrow range of issues that are of particular concern to the agency. Rather than broadly managing the agency's technology portfolio, they focus on a few specific on-going initiatives or advancing a specific portion of the technology agenda. Some CTOs are deployed to fix a specific problem the agency is encountering with its technology, not dissimilar to the role of a consulting group deployed to solve a particular area of concern.

## 5. TECHNOLOGY WORKFORCE DEVELOPMENT

Some CTOs mentioned their role in managing their agency's technology workforce. Much has been written about the difficulties faced by the federal government in attracting and retaining the technology workforce of the future, and data on the demographics of the federal technology workforce paint a challenging picture. Some CTOs are charged with identifying gaps in their agency's workforce and working to rectify those gaps. Some are also responsible for shaping the career paths of their agency's technology workforce as a way to improve retention.

## 6. STRATEGIC POSITIONING

Many of the CTOs said that they focus primarily on short or mid-term issues, generally less than three years in length. However, a minority said that they were responsible for longer term, strategic positioning. For this latter category of CTOs, their primary concern is understanding what "the business" will look like in the future and how to position their agencies to be best prepared to succeed. One respondent said, "CTOs should not be buried in operations issues. They need to drive the future of technology and create roadmaps for their agencies."

Another respondent said that CTOs need to be looking at the longer-term consequences of today's actions, such as being involved in the development in the agency's cloud strategy to avoid future lock-in.

Even CTOs who generally limit their focus to the next three years seem to maintain a strategic or "big-picture" view. To illustrate this point, one respondent highlighted their experience with federal data center consolidation: "every agency [within the Department] knows their own numbers, but it is the role of the CTO to bring it together and understand what it means for the [Department] as a whole."

# ORGANIZATIONAL PLACEMENT AND AUTHORITY

As with roles and responsibilities, the organizational placement of CTOs within their agencies varies widely. The CTO's relationship with the agency Chief Information Officer (CIO) has a significant effect on the authority and primary responsibilities of the CTO. The relationship to the CIO is important because, unlike the CTO, the role of the CIO was established in statute 20 years ago and, despite some continuing challenges, has a defined scope and carries with it an operating budget, significant staff, contract support, etc.

Nearly two-thirds of the 23 departments and agencies included in the Chief Financial Officers Act of 1990 currently have CTOs. Of these, most report to their respective CIO, with the others generally reporting directly to their organizations' director or secretary.

## THREE STRUCTURES

The organizational relationship between CTOs and their respective CIOs can be sorted into three broad structures:

- 1. Direct Report to CIO.** The CTO is a direct report to the CIO, often as a peer to the Chief Data Officer and/or the Chief Information Security Officer (CISO). In this structure, CTOs gain their authority in large part through the statutory authority of the CIO.
- 2. Independent Report.** The CTO is not in the reporting chain of the CIO; in these cases, it is often structured as a peer to the CIO or as an independent advisor, often reporting to the agency head or deputy agency head.
- 3. Dual-Hatted.** In a few cases, the CTO is dual-hatted as the CIO.

Each of these organizational models provides a unique set of opportunities and challenges.

## DIRECT REPORT TO CIO

One respondent noted that "I don't know how I would do my job if I did not report to the CIO. The CIO has the budget and the authority; if the CTO was not a direct report to the CIO, the CTO would simply go off and make plans that would never get implemented."

"It would be disastrous to pull the CTO out of the CIO chain, just as it would be disastrous to pull the CISO out of the CIO chain," remarked another respondent. Interestingly however, another respondent who advocated for the CTO being independent from the CIO also advocated for the CISO being a direct report to the agency head.

One respondent noted that when the CTO reports to the CIO, the working relationship between CIO and CTO is absolutely vital. In particular, conflict can arise if one approaches problems with a technical focus while the other has an organizational or bureaucratic focus.



## INDEPENDENT REPORT

When the role of CTO and CIO are fully independent of each other, the CIO is often focused inwardly on managing and maintaining current systems, while the CTO is focused on identifying, validating, and adopting technology from outside the organization, particularly as it relates to mission technology.


Respondents highlighted that for this arrangement to work, a clear delineation of roles, responsibilities, and authorities is vital.

The primary benefit of this arrangement is seen as facilitating direct access between the CTO and the agency head. This is noted as particularly important in agencies where technology is central to mission delivery. “If technology is central to mission, the agency head needs a technology advisor, similar to how they need a general counsel. That used to be what the CIO was responsible for, but now the CIO is more focused on ‘keeping the lights on.’”

Another respondent emphasized that if a CTO is subordinate to a CIO, then they really aren’t a chief of anything, “Chief means final decision maker. The CTO needs to have final decision authority over technology. If they do not, they become just one voice among many.” Moreover, some respondents noted that CTOs are able to have a far greater impact if they are not positioned under their CIO, as they are able to take on more controversial, outside-the-box, approaches.

Finally, one respondent highlighted that “the CIO isn’t in charge of all information technology. If they were, maybe then it would make sense for the CTO to be under the CIO. But as it is, there are plenty of areas for a CTO to focus on which do not impede on the CIO’s role.”

## DUAL-HATTED



In some cases, the agency CIO is also formally designated as the CTO. This is an uncommon situation and, in the rare cases where it exists, it is difficult to distinguish which roles and responsibilities fit with which title. From the interviews, it was unclear when having a dual-hatted CIO/CTO would be the most beneficial structure. One respondent asserted that the dual-hatting of a CTO, without clear delineation of the responsibilities falling under each role, was possibly a public relations move to showcase a “renewed focus on innovation,” rather than a substantive organizational decision. It should be noted that some agencies don’t have a designated CTO, and so the CIO performs the CTO functions without a “dual hatted” title.



## A STATUTE FOR CTOs?

As one might expect, the organizational relationship between the CTO and the CIO greatly influences the view on the need for legislation to establish the role of the CTO. In general, CTOs who work under the CIO felt that they derived their authority through the statutory authority of the CIO, and therefore saw no need for additional legislation.

The opinions of the CTOs who are independent of the CIO are more varied. Many believe that legislation may be helpful in overcoming cultural resistance, providing legitimacy to the CTO's role, and helping to communicate the CTO's role to the outside world. In this view, legislation could clearly establish and articulate accountability with measures and feedback. Importantly, many felt that they are currently reliant on the "power of personality" to advance their agenda, and that while this may work for certain individuals, it limits others who may have great technical expertise but lack the personality or reputation to drive substantial change without formal authority.

In addition, some CTOs noted that legislation would be important to sustain the role of CTOs from one administration to another. Government technology adoption is already hampered by the short tenure of many agency leaders. This problem is exacerbated when the roles and responsibilities of the position, rather than just the individual holding the position, change from administration to administration.

However, many of the respondents, even those who support legislation, expressed substantial concern about legislation that would overly standardize their roles and responsibilities, inhibit flexibility, and stifle the ability of agencies to empower their CTO in a way that most makes sense within their organization's structure and mission. In short, some expressed concern that legislation would lead to a one-size-fits-all position ill-suited to actually addressing the unique needs of their organization. Moreover, some highlighted the importance of ensuring that legislation does not impinge on the current authorities or responsibilities of CIOs or Chief Acquisition Officers.

## THE CTO COMMUNITY

### CHIEF TECHNOLOGY OFFICER OF THE UNITED STATES

The position of the Chief Technology Officer of the United States (U.S. CTO) was established by administrative action by President Obama in 2009. This position is primarily that of a senior technology advisor to the President, but is on the staff of the Office of Science and Technology Policy within the Executive Office of the President. Since the establishment of the position, the role of the position has shifted to reflect the priorities of the three incumbents who have held the job. The U.S. CTO does not have extensive engagement with agency CTOs, and does not function as a “head CTO,” providing guidance and leadership to agency CTOs (as the Federal CIO does for agency CIOs).

Many respondents noted that it would be helpful if the U.S. CTO played the role of a “head CTO,” not by directly managing the agency CTOs, but by helping to foster a community, increase cooperation, and spread best practices among agencies. If this were to be the case though, consideration should be given to aligning the U.S. CTO with the Federal CIO within the Office of Management and Budget, while maintaining “reach back” to the skill sets and staff at the Office of Science and Technology Policy. Respondents also noted that there are many issues that are similar across the different agencies (e.g., cloud, mobility, the Internet of Things, etc.) and that there is an opportunity for the U.S. CTO to take the lead. One respondent commented, “The U.S. CTO should look at technologies across government, exchange ideas with industry, and help forge the path for adoption on these high level broad areas,” while ensuring accountability of agency CTOs.



## CROSS-AGENCY ENGAGEMENT

When asked about the need for a formal CTO Council, akin to the current Federal CIO Council, there were mixed responses. Some strongly believe that a CTO Council is needed, with one stating, “A CTO Council would be helpful. I don’t even know who all of the other CTOs are.” Others said that a formal council is not needed, but that informal interaction between CTOs is vital. One CTO stated, “Many of the problems are shared across the government, so sharing is important.” Another CTO noted, “There are good things happening across government, and they need to be shared.”

Some CTOs did mention their frequent engagement with other CTOs, and some even mentioned unofficial group gatherings. CTOs agreed that even if a formal CTO Council is not established, it is important that these informal efforts continue and are expanded to include more CTOs, especially those who are new to their position.

## VIEWS FROM THE INDUSTRY CTOs

**While the nature of the CTO role in industry differs from that at federal agencies, industry CTOs do have advice on best practices that are applicable to their federal counterparts:**

- **HQ CTOs must be empowered by having more budget authority, specifically for applied innovation projects. It is crucial to be able to fund experiments that demonstrate the value of new technology adoption.**
- **It is important to recognize that the adoption of new technology solutions is often expected not only to deliver more effective outcomes but also to produce tangible efficiencies. The CTO must contribute to both of these goals.**
- **CTOs must spend a significant portion of their time out of the office identifying and evaluating emerging technologies for potential adoption to meet mission needs.**
- **Great CTOs are outstanding communicators, able to clearly articulate a vision and instill a passion to succeed.**
- **Effective CTOs work closely with product management teams to highlight new initiatives that will be going to market as well as relentlessly sharing success stories to enable peer groups to benefit from adjacent ‘wins.’**

# PSC RECOMMENDATIONS

## **1. Federal agencies should designate a CTO and ensure that the position has the requisite authorities to effect change and is focused on delivering innovation.**

There is a compelling need for the government to more rapidly and effectively adopt new commercial technologies. The CTO position, if structured effectively, can be an important innovation agent for the agency. This opportunity is only enhanced by the increasing importance being placed on digital government solutions. However, it is important to recognize that the priorities of a CTO should and will vary by the level within an agency in which they work. At the HQ/enterprise level of an agency, the CTO will be much more involved in implementing enterprise-wide solutions and aligning technology needs with agency-wide goals and business processes. Within component organizations at an agency, the CTO may be much more focused on introducing new technologies to support specific mission systems and local business needs. There is a likelihood that bureau-level CTOs will be less involved in governance and process change and more involved in alignment of R&D expenditures and the incorporation of new technologies within specific programs and systems.

CTOs must:

- Track emerging technologies and help determine when and how to leverage them within their organization.
- Connect external customers to the organization and focus on how technology can make the agency more effective.
- Champion technology insertion and pilot solutions to help move the agency off aging, outmoded and expensive legacy technology to more cost effective solutions. Identifying funding for innovation efforts, creating an “innovation sandbox” and conducting pilots, prototypes, experiments and proofs of concept will all improve agency results.
- Develop technology roadmaps aligned with both commercial best practices and the agency’s strategy and major program needs; encourage and support key stakeholders to do sufficient market research to understand the applicability and value of specific technology solutions. CTOs that perfect the art of roadmap development and sustainment are more successful at inserting innovative products and ideas.
- Collaborate with both industry and academia to gather best practices, ideas and approaches. CTOs should understand where their commercial partners’ industries and markets are moving to ensure their agency’s plans adapt as technologies emerge.
- Focus on mission-related technologies and evaluate technologies against mission needs. Collaborate with internal “business owners” to ensure understanding of key gaps, desired outcomes and evolving priorities.
- Participate in the investment review process, PortfolioStat, FITARA reviews, etc., to ensure projects align with the technology roadmap – including agile methods, cloud computing and other models that aren’t well served by traditional capital planning and investment review processes.



- Ensure an agency architecture is in place that addresses interoperability and alignment of agency technology efforts.
- Have adequate staff and budget to carry out their responsibilities.
- Facilitate a safe environment for break-through ideas to be effectively shared—enabling participation from across the agency.
- Present their agency’s vision clearly; coach and negotiate where needed to ensure adoption of the vision, and instill a passion to succeed.

## **2. The CTO should have an explicit working relationship with the agency CIO.**

The CTO should be a direct report to the CIO, ensuring alignment, partnership on key initiatives and agency goals, accountability and much needed collaboration to avoid working on what could otherwise be competing priorities and paths forward that would result in fragmentation and silos of innovation. Given the organization of federal agencies, the CIO must continue to be the business leader for all of the aspects of IT management and delivery. The CIO is accountable for an agency’s IT operations and must make business decisions impacting those IT operations. Given this reality, IT project success is dependent on the synchronization of agendas among all key stakeholders.

Too often, there is the temptation to work around the existing organizational structure rather than fixing it. If a CIO is reluctant to change or does not have the technical or managerial wherewithal to affect change, the solution is not to hire an independent CTO, but rather to replace the CIO with a new person who shares the vision, values and agenda of the agency leadership and is capable of leading the IT organization.

The CTO, like the CISO, should be a key deputy to the CIO, not in separate chains of command. Agency heads should avoid the lack of accountability and finger pointing that ensues when multiple independent actors are responsible for parts of the technology agenda, and instead, ensure a unified team is working together, with clear accountability, to deliver results.

## **3. The U.S. CTO should move from OSTP to OMB, working for the Federal CIO.**

Given the crucial role that technology plays, there is great value in having a U.S. CTO. However, the current structure and organizational placement is not optimal. For the U.S. CTO to provide leadership for agency CTOs, the position should be moved out of OSTP and into OMB. Serving as a member of the staff of OSTP minimizes the ability of the position to direct change at federal agencies. By moving the position to OMB and aligning it with the Federal CIO, the U.S. CTO’s agenda will remain aligned with the broader set of federal IT priorities and the U.S. CTO will also be able to leverage the staff, reach and authorities of the Federal CIO.



#### 4. Establish a CTO Council.

Collaboration on technology efforts and opportunities is crucial, and many agency CTOs currently engage in informal collaboration with their peers. Establishing a CTO Council would enhance the sharing of success stories, best practices and solutions that can be leveraged by agencies. The U.S. CTO should chair the CTO Council and the council should also include participation by other government innovation agents, to include DARPA, IARPA, NSF, NIST, etc. The CTO Council could provide a forum for agency CTOs to discuss complex business problems requiring innovative technical solutions in a setting where everyone can share their expertise and lessons learned to help move the federal technology agenda forward more quickly and with greater support. The CTO Council could also provide a venue to engage with industry, as modeled by the CIO, CFO, CHCO and CAO councils. The CTO Council could host periodic industry open forums where the CTO Council identifies areas of interest for the government and companies could offer technology information and demonstrations. Efforts such as these would foster industry/government dialogue about capabilities that will become available for purchase, benefiting industry with customer feedback and helping agencies position properly to take advantage as they formulate budgets well in advance of actually seeing those funds become available for applied use.

#### 5. Only consider CTO Legislation if it will help empower agency CTOs as innovation agents.

Legislation is not a prerequisite to federal agency CTO success. Executive Branch leadership, action and attention are all that is needed to formalize the role of the CTO, establish a CTO Council and demand better technology outcomes for government. If a decision is made to pursue legislation as a way of pushing for the changes proposed in this report, then we recommend amending FITARA to address the skills, experience and priorities for CTOs—aligned with CIOs and able to leverage CIO authorities and resources.



#### NEXT STEPS

Empowering and enabling federal agency CTOs to deliver on the promise of technology and innovation will produce powerful results. Regardless of where they are positioned organizationally, agencies must clearly define roles and expectations for their CTOs, developing position descriptions and recruiting CTOs that can meet their agency's goals. It is important that a CTO has an understanding of new technologies, the mission and priorities of the agency, the ability to work well with industry and academia and the vision to translate technology trends into agency mission results. Government and industry CTOs agreed that federal agency CTOs can be a powerful force for government transformation by articulating how technology can be leveraged to address mission needs and deliver results. Now is the perfect time to implement these recommendations!

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