Smart Contracts in the Federal Government – Leveraging Blockchain Technology to Revolutionize Acquisition

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Acquisition Research:
Creating Synergy for Informed Change
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Agenda

- **What is an FFRDC and Who is MITRE?**
- **Introduction to Blockchain**
- **Smart Contracts Overview**
- **Using Smart Contracts in Government Acquisition**
- **Our Prototype**
- **Acquisition Use Case – Using Smart Contracts to Acquire Software Licenses**
- **Questions**

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What is an FFRDC and Who is MITRE?
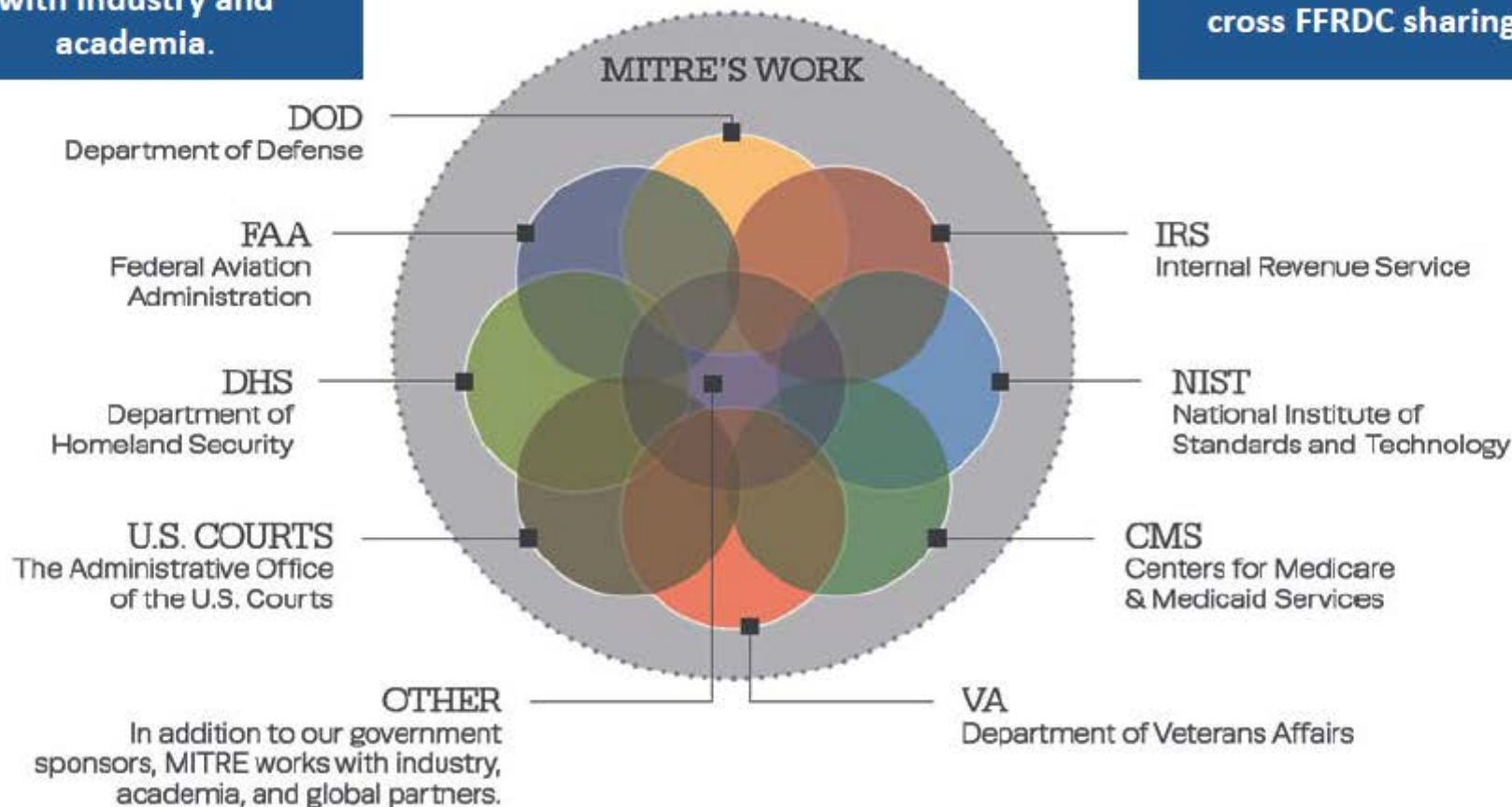
How is an FFRDC Different*?

- **Performs work that cannot be done effectively** by in-house or commercial contractor resources
  - Industry not incentivized or equipped to deliver
  - Needs undefined at start, limiting ability to "acquire" competitively
  - Diverse skills, tools, and government entities working together
- **Is a federal entity** operated by independent, not-for-profit institutions
  - Operate as long-term strategic partners with their sponsors
  - Organized as independent entities and operate free from organizational conflicts of interest
  - Bring together expertise and outlook of government, industry, and academia to solve complex technical problems
- **Enables agencies to use private-sector resources** to accomplish tasks integral to the mission and operation of the sponsoring agency

* Federal Acquisition Regulation (FAR) Part 35.017

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MITRE Context

Because we operate seven different FFRDCs, our sponsors reap the benefits of research and expertise that cut across our entire organization.

We serve as a bridge between government agencies and as a channel for agencies to collaborate with industry and academia.

MITRE's collaborative culture is an asset for cross FFRDC sharing.

MITRE'S WORK

DOD
Department of Defense

FAA
Federal Aviation Administration

DHS
Department of Homeland Security

U.S. COURTS
The Administrative Office of the U.S. Courts

OTHER
In addition to our government sponsors, MITRE works with industry, academia, and global partners.

IRS
Internal Revenue Service

NIST
National Institute of Standards and Technology

CMS
Centers for Medicare & Medicaid Services

VA
Department of Veterans Affairs

CAMS — Center for Acquisition and Management Sciences

Acquisition Strategy Development

Cost Analysis

Business and Investment Analysis

Contract Strategy Development

Risk Management

Program Management

Strategic Initiatives and Reforms

Independent Program Assessments

Delivering Conflict-Free Innovative Acquisition Solutions Across the Federal Enterprise

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Introduction to Blockchain

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What's a Blockchain?

- **Decentralized network of machines that all do the same thing (replicated clones)**
  - They all execute the same business logic against the same logic
  - The all share a common view of the current state of the data
  - A transaction is not final until the majority of the network agrees to it
- **Based on cryptography and decades of research in distributed computing**
- **Designed to help enforce trust in the transactions exchanged among parties**
- **How's it different than what we do today:**
  - In most current systems, someone owns and controls the database and associated business logic. They dictate the terms and conditions of using the system. They are the "source of truth"
  - With a blockchain, the system is controlled through a machine driven consensus process shared among the participating parties
- **When should you consider a blockchain?**
  - When you want to decentralize the business process
  - When process stakeholders do not want to rely on a single party controlling the system
  - When you want to *trust but verify* transactions without relying on a middleman

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Centralized Databases vs. a Blockchain

- **Centralized databases are controlled and maintained by an administrator**
  - Administrator can create, modify, and delete data at any given time
  - Administrator can delegate and provide rights to read or write data to other users
  - More inclined to be hacked or misused due to single point of control of the data
  - Data will be lost if not backed up

- **A blockchain is a database in the form of digital ledger but a database is not a blockchain**
  - Does not require assistance from an administrator or traditional centralized services
  - Single node failing will not bring the whole system down and more difficult to hack than a traditional database
  - Data is permanently stored on multiple machines or nodes
  - Transactions may be processed at slower speeds than traditional databases

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Smart Contracts Overview

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Blockchain and Smart Contracts

- Smart contracts are **lines of code** that are stored on a blockchain and are triggered when incoming transactions' predetermined terms and conditions are met.

- Smart contracts provide **business logic** to help you exchange money, property, shares, or anything of value in a transparent, conflict-free way while avoiding the services of a middleman.

- Smart contracts can be programmed to **define the rules and penalties around an agreement** in the same way that a traditional contract does, in addition to **automatically enforcing** those obligations.

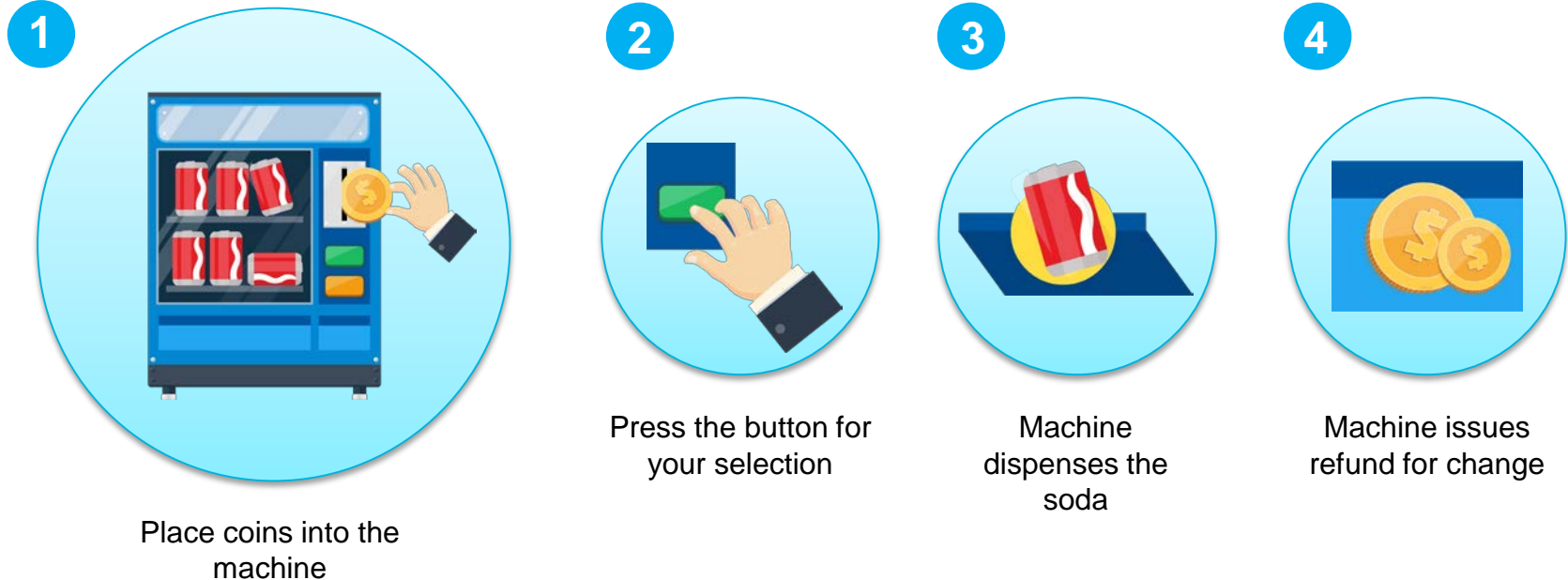- **Smart Contracts Benefits:**

Autonomy **Trust** **Backup** **Savings**

Accuracy **Speed** **Safety**

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Vending Machine – A Basic Smart Contract Example

Example of a "smart contract"

① Place coins into the machine

② Press the button for your selection

③ Machine dispenses the soda

④ Machine issues refund for change

The transaction occurs without the presence of a middleman.

Source: MITRE

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Purchasing a Soda at a Convenience Store – The Status Quo (e.g. dumb contracts)

1 Select your soda from the cooler

2 Take it to the counter

3 Clerk scans the Soda

4 Hand clerk the money

5 Clerk enters the amount paid into the register

6 Clerk gets refund out of register

7 Clerk hands refund to you

…and if paying by credit card, this transaction becomes even more complex.

Source: MITRE

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Using Smart Contracts in Government Acquisition

Dumb Contracts vs. Smart Contracts

- **Current methods for writing contracts could be described as "dumb"**
  - Process is slow and involves labor-intensive activities
  - Process is repetitive for many of the acquisitions and procurements for commercial goods and services
  - Processes for contracting and acquisitions may or may not be documented within an organization, leading to differences even between groups within the same office

- **Blockchain-based smart contracts enable automation of dumb contracts**
  - Benefits of smart contracts: autonomy, trust, backup, safety, speed, savings, accuracy
  - Smart contracts are only as good as the logic programmed in them

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Sweet Spot for Smart Contracts in Government Procurement

- **Procurement entails all of the goods and services a government purchases from its vendors (private sector, non-profit, etc.)**
- **Stable and repeatable contract terms and conditions**
- **Lots of previous contract data**
  - Price
  - Quantity
  - Quality
- **Well-defined products and services**
- **Stable requirements**
- **Commodities are good targets**
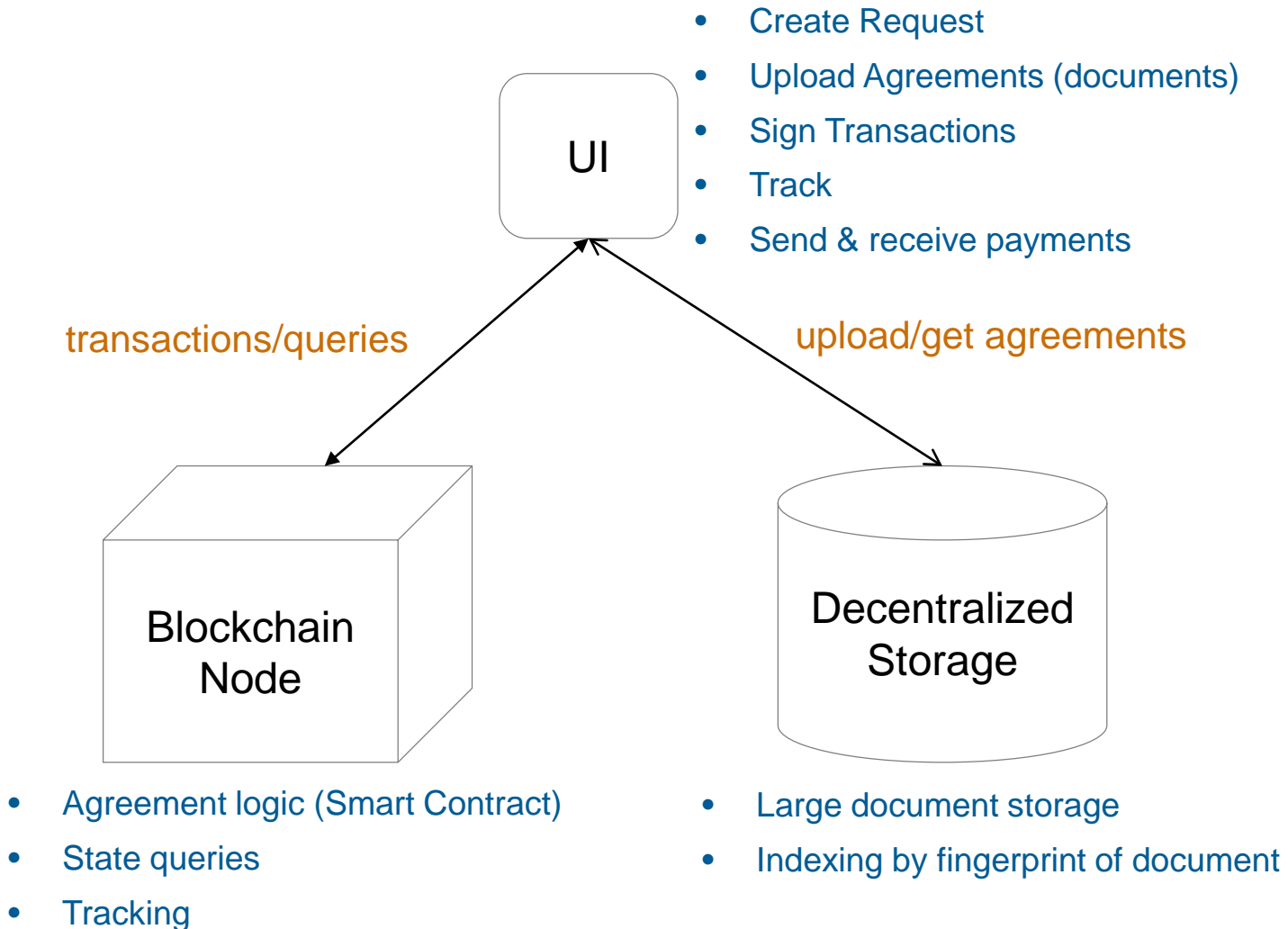- **High volume purchases**

GOAL

REALITY

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Our Prototype

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Our Research Is Focused on Using Smart Contracts in Government Acquisition for…

1 AGREEMENT

TRACKING 2

3 PAYMENT

Source: MITRE

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Prototype Architecture

UI

- Create Request
- Upload Agreements (documents)
- Sign Transactions
- Track
- Send & receive payments

transactions/queries

upload/get agreements

Blockchain Node

Decentralized Storage

- Agreement logic (Smart Contract)
- State queries
- Tracking

- Large document storage
- Indexing by fingerprint of document

Source: MITRE

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Prototype Results and Recommendations for Successful Implementation of the Smart Contracts

- **Prototype results from the beginning of FY19 through date of this research include:**
  - A blockchain and smart contracts was used to capture, track, and enforce the rules of an agreement
  - A cryptographic "wallet" was created for every user who intends to interact with the system
  - A decentralized notary service was established to verify, and process digital signatures required by the documents associated with the process
  - A rules-based flow was established to enforce the agreement through the process
- **Prototype resulted in process agreement generation, document signatures, and money transfers being recorded on the blockchain in an immutable, auditable ledger and available for all parties to examine**

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Smart Contracts - Not Just for Acquisition

- **We believe our research can be applied to problems that have been hindering systems for decades.**
- **Agreements are core to nearly every information system.**
- **The goal of our research is to establish and enforce agreements among external and internal parties to a decentralized process.**
- **Examples:**
  - **Information Sharing** (intel, coalition, space …)
    - Controlling who can access or share information
  - **Asset exchange** (people, equipment …)
    - Tracking and maintaining SA of our assets while enforcing the rules of exchange
  - **Delegation of authority** (who can act on my behalf)
    - The rules and integrity associated with delegating authorization/authority, e.g. command and control
  - **Audit trails** (provenance, integrity …)
    - Decentralized audit trails to establish trust and integrity in the processes above
- **Our agreements network can provide a baseline for others to build on—providing a common fabric for next generation services.**

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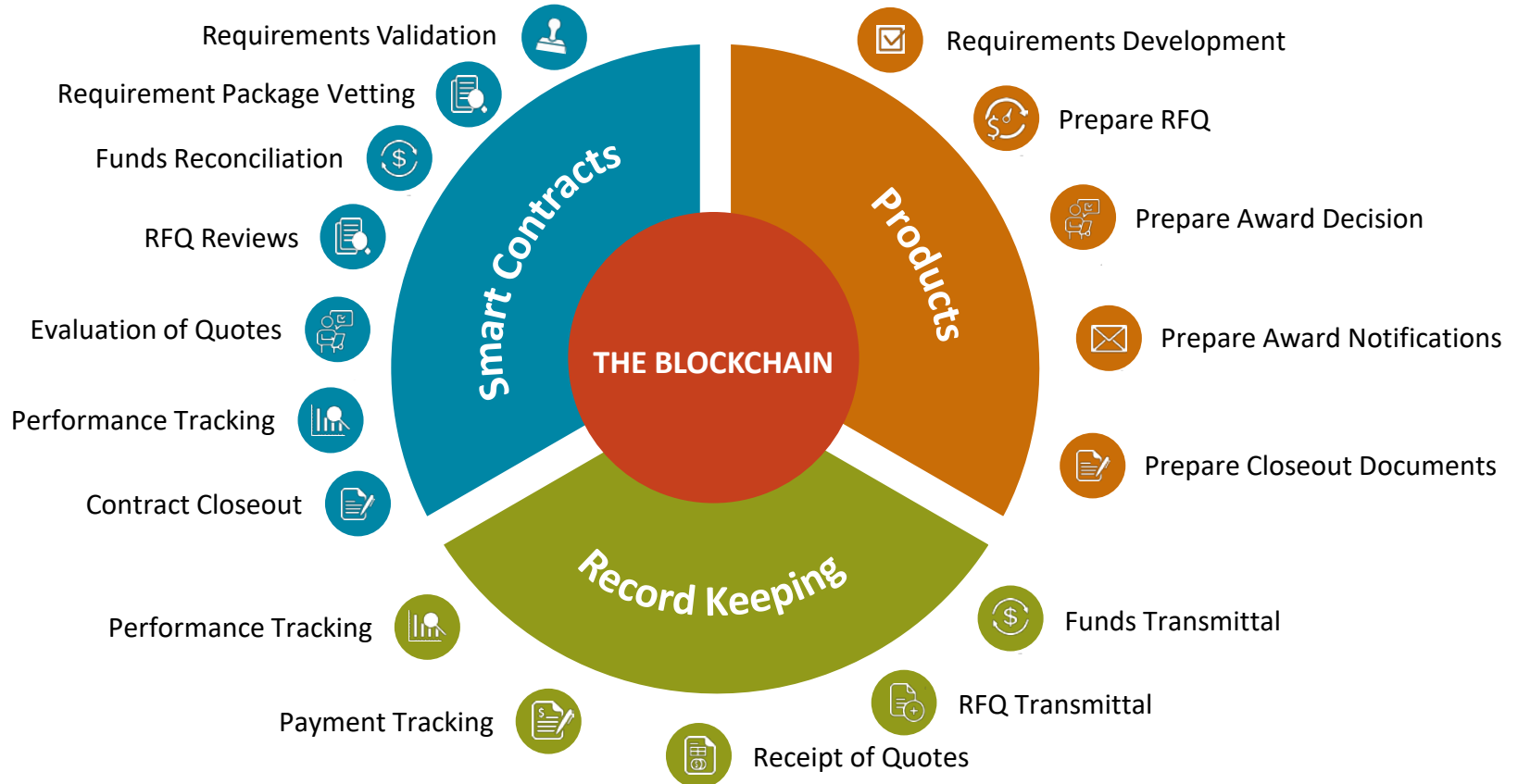# Information Sharing – A Smart Contracts Example

- **The Air Force must exchange information for the F-16 program with a vendor who is coming on to support the rollout of a new radar system**

- **The new vendor does not yet have access to any data from the Air Force or current F-16 program vendors**

- **Data will come from a wide variety of government/industry sources (could also be inter-agency/international)**

- **In lieu of a paper-based/pdf-based data sharing agreement, a smart contract is used**

- **A smart-contract based <u>agreements layer</u>**
  - Can help automate and enforce access to data across organizational boundaries.
  - No more chasing down data permissions and manually filling out paperwork!

- **A smart-contract based <u>tracking layer</u>**
  - Can monitor the exchange of the data based on the rules via the agreement layer (who is accessing, how often, etc.) which establishes an audit log.
  - This ensures nobody is manipulating data or using it outside the boundaries of the pre-determined agreement terms and conditions.

- **A smart-contract based <u>payment layer</u>**
  - Can be representative of the costs associated with gaining access to the data.
  - Operations, maintenance, and collection of the data being used could be subsidized by third parties who "pay" for on-demand access to the data.
  - This drives more transparent and equitable cost sharing across program partners who can pay for whatever they use by transferring funds to the data owners who provide access for a government purpose

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Acquisition Use Case – Using Smart Contracts to Acquire Software Licenses

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Applying Blockchain & Smart Contracts Principles to COTS Software Acquisition

Smart Contracts
- Requirements Validation
- Requirement Package Vetting
- Funds Reconciliation
- RFQ Reviews
- Evaluation of Quotes
- Performance Tracking
- Contract Closeout

THE BLOCKCHAIN

Products
- Requirements Development
- Prepare RFQ
- Prepare Award Decision
- Prepare Award Notifications
- Prepare Closeout Documents

Record Keeping
- Performance Tracking
- Payment Tracking
- Receipt of Quotes
- RFQ Transmittal
- Funds Transmittal

Source: MITRE

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Requiring Activity Typical Process

Step 1 - Determination of a requirement

Step 2 - Seek requirement validation/approval from Agency (processes vary by agency)

Step 3 - Secure, commit, and transfer funding to Contracting Office

Step 4 - Transmit approved requirements package to Contracting Officer (KO)

Source: MITRE

MITRE

Contracting Office Typical Process

Step 1 - Review requirements package for sufficiency

Step 2 - Prepare the RFQ

Step 3 - KO seeks RFQ approvals from contracting chain (JA, Policy, Supervisor, Peer Review)

Step 4a - Post RFQ on GSA eBuy IAW FAR 8.405-1(d)(3)

Step 4b - (alternate to 4a above) - Transmit RFQ to specific vendors

Step 5 - Receive quotes

Step 6 - Evaluation of quotes

Step 7 - Award decision

Step 8 - Award notification

Step 9 - Tracking contract performance

Step 10- Contract payment

Step 11 - Contract closeout

Source: MITRE

MITRE

Requirements Determination and Approval

Requiring Activity - Step 1
DETERMINATION OF A REQUIREMENT
- Define needed software related capabilities.
- Build Independent Government Cost Estimate (IGCE).
- Perform market research and determine industry capabilities, products, and standards.
- Prepare justification for need for agency approval.
- No agreement is established in this step.

Requiring Activity - Step 2
SEEK REQUIREMENT VALIDATION/APPROVAL FROM AGENCY (processes vary by agency)
- Seeking requirements validation/approval initiates the agency tracking process. This process varies by agency and can be done using spreadsheets, databases, or other systems. Many organizations prepare monthly or weekly reviews/reports summarizing all ongoing requirements.
- End State - Normally results in an approved/signed memorandum providing authorization to proceed with procurement.

Step 1 – Pain Points
- Competition requirements and the trend for performance-based work statements makes preparing the work statement/specifications difficult and cumbersome – especially for non-acquisition personnel.
- Often, people performing market research are not familiar with available strategic sources.

Step 1 – Smart Contracts Benefits

Autonomy   **Speed**

Step 2 – Pain Points
- Sometimes, too many unnecessary parties are involved in the validation process, creating potential roadblocks.
- Final approval authority is often times assigned at high levels within an organization, which could delay the process.

Step 2 – Smart Contracts Benefits

Autonomy   **Trust**

Source: MITRE

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Funding Approval and Package Transmission

Requiring Activity - Step 3

SECURE, COMMIT & TRANSFER FUNDING TO CONTRACTING OFFICE

- Requires the funding be routed and approved, normally through at least three different levels.
- Result is an electronic transmission of a "certified funding document" that commits/reserves funding for the procurement.
- For DoD, funding activities are tracked and certified through formal IT systems such a GFEBS.

Requiring Activity - Step 4

TRANSMIT APPROVED REQUIREMENTS PACKAGE TO CONTRACTING OFFICER (KO)

- Transmitting approved requirements package (with funding) is performed differently for different agencies.
- Army uses the Paperless Contracting File (PCF) system to transmit requirements packages. Other agencies utilize different systems.
- Some agencies do not automate this system, and instead rely on email.

Step 3 – Pain Points

- Funding certifications can be slowed by systems issues.
- Some funding approvals include cumbersome approval chains with personnel that have few equities (i.e. requiring a property book officer approval funding for a service that includes no property).
- Multiple business interface issues.

Step 3 – Smart Contracts Benefits

Trust

Speed

Step 4 – Pain Points

- Oftentimes, requiring activities submit the package to contracting in disjointed increments.
- Sometimes, there is dispute on when a package is actually submitted.

Step 4 – Smart Contracts Benefits

Accuracy

Source: MITRE

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Questions?

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Backup

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Requirements Review and RFQ Creation

Contracting Office- Step 1
REVIEW REQUIREMENTS PACKAGE FOR SUFFICIENCY

- KO receives requirements package and conducts review of multiple requirements documents for completeness and sufficiency.

- KO provides comments to Requiring Activity for further adjudication, or

- KO accepts the requirements package as submitted.

- The agreement is a form or memorandum that accepts or rejects the requirements package. If rejected, the form/memo will provide details on what the Requiring Activity needs to correct before resubmittal.

Contracting Office - Step 2
PREPARE THE RFQ

- The KO prepares a Request for Quotation IAW FAR 8.405-1(d)(2), which includes the basis upon which the selection will be made (i.e. source selection criteria).

- The KO determines which GSA Special Item Number (SIN) grouping and category (i.e. IT-70, 132-32 Term Software License) that best fits the requirement.

Step 1 – Pain Points

- Bottleneck & backlog of package reviews.

- Disputes regarding quality of documents.

- Sometimes contracting is brought into the acquisition too late to affect tight milestones.

Step 1 – Smart Contracts Benefits

Accuracy

Step 2 – Pain Points

- Inexperienced contracting officers could apply source selection boilerplate criteria that are not right-sized.

- RFQ could include inappropriate clauses or provisions.

- Contracting could send the RFQ to the wrong SIN grouping, which could exclude a pool of potential vendors.

Step 2 – Smart Contracts Benefits

Backup   **Accuracy**   **Safety**

Source: MITRE

MITRE

RFQ Approval and Posting

Contracting Office - Step 3
KO SEEKS RFQ APPROVALS FROM CONTRACTING CHAIN (JA, Policy, Supervisor, Peer Review)

- To track approvals, agencies use various systems and processes such as a Paperless Contracting File (PCF) or rolling spreadsheets, including date stamps, rejections, and resubmittals
- Once JA, policy, supervisor, and peer review approvals are completed, the KO receives an approval message in PCF, along with various memos providing RFQ review approvals.

Contracting Office - Step 4a
POST RFQ ON GSA EBUY IAW FAR 8.405-1(D)(3)

- RFQ is posted electronically via GSA eBuy and is available to all GSA Federal Supply Schedule holders within the pre-selected SIN Grouping.
- RFQ remains visible with a time stamp on eBuy website until the RFQ closes.

Step 3 – Pain Points

- Sometimes, approval chain is not right-sized for the acquisition (i.e. having the chief of Policy review the package).
- Too much back-and-forth on review comments and adjudication.
- Potential bottlenecks due to Policy Team staffing levels.

Step 3 – Smart Contracts Benefits

Savings   **Speed**

Step 4a – Pain Points

- The eBuy system is a closed system, and only those parties/personnel designated initially can see the RFQ. This makes it difficult if the one government KO is out of the office and the supervisor would like to review. This requires that he/she be added to the eBuy permissions, which adds another touchpoint.

Step 4a – Smart Contracts Benefits

Safety

Source: MITRE

MITRE

RFQ Posting and Receipt of Quotes

Contracting Office - Step 4b (alternate to 4a above)
POST RFQ ON GSA EBUY IAW FAR 8.405-1(D)(3)
- IAW FAR 8.405-1(d)(3), the KO sends the RFQ to as many schedule contractors as practicable, to reasonably ensure that quotes will be received from at least three contractors that can fulfill the requirements.
- RFQ is transmitted electronically via GSA eBuy, but is not fully visible to entire SIN Grouping.

Contracting Office- Step 5
RECEIVE QUOTES
- Upon the RFQ closing date, the KO automatically receives all submitted quotes via the GSA eBuy portal. All quotes are time stamped in the system, and late quotes are not accepted.

Step 4b – Pain Points
- Similar concerns as those listed in C-4a.

Step 4b – Smart Contracts Benefits

Autonomy   **Safety**

Step 5 – Pain Points
- Sometimes the portal limits the size of files to be submitted, requiring files be submitted alternatively by e-mail, FTP sites, hand-delivery, and other alternative methods.
- Could pose complications on the time stamp of delivery, raising questions of timeliness/lateness of quotes.

Step 5 – Smart Contracts Benefits

Backup   **Accuracy**   **Safety**

Source: MITRE

MITRE

Evaluation of Quotes and Award Decision

Contracting Office - Step 6
EVALUATION OF QUOTES

- The KO convenes a team to evaluate the quotes in accordance with the non-price evaluation criteria listed in the RFQ. Evaluation criteria could include items such as technical suitability, cyber protection, past performance, warrantee, and other factors.

- The evaluation team reviews all quotes and provides a consensus of findings (strengths, weaknesses, deficiencies) to the KO.

- This consensus is often provided in the form of a memo.

- Some evaluation activities utilize automated systems such as the Army's Acquisition Source Selection Interactive Support Tool (ASSIST).

Contracting Office - Step 7
AWARD DECISION

- The KO reviews the Evaluation Team's findings and makes a written final determination of which quote represents the best value to the government in terms of price and non-price factors listed in the RFQ.

- The KO accepts the quote that represents best value to the government and creates the award document. In this case, the KO creates a GSA FSS Order in their agency contract-writing system.

Step 6 – Pain Points

- Evaluations require that team members be impartial and conduct evaluations impartially and only in accordance with the terms of the RFQ.

- Sometimes, evaluations are delayed by the availability of participants.

- Poorly conducted evaluations can lead to increased risk of protest.

Step 6 – Smart Contracts Benefits

Speed

Step 7 – Pain Points

- In the absence of strong, supportable technical evaluations, the tech board could reconvene adding schedule delays.

- In some cases, a subjective tradeoff analysis (and award decision) is required. If the KO is inexperienced, he/she may perform the tradeoff analysis incorrectly and insert protest risk into the acquisition process.

Step 7 – Smart Contracts Benefits

Accuracy   **Speed**

Source: MITRE

MITRE

Award Notification and Contract Performance Tracking

Contracting Office - Step 8
AWARD NOTIFICATION

- The KO notifies all interested parties (including the awardee) of the award selection decision.

- The KO posts this award decision in GSA eBuy. Additionally, the KO notifies all unsuccessful offerors of the award decision, normally by letter.

- The KO provides a copy of the signed contract/GSA Order to the awardee.

Contracting Office - Step 9 /Requiring Activity Step 5
TRACKING CONTRACT PERFORMANCE

- The Contractor then performs the work in accordance with their quote and the resulting contract award.

- In some cases, the KO appoints a Contracting Officer's Representative (COR) to perform government surveillance of contractor performance and deliverables.

- If no formal COR is assigned, the KO designates a government representative to track contractor performance and ensures all supplies and services are provided IAW the terms of the contract/order.

- Once the government representative/COR determines that the contractor has met the terms of the contract, he/she notifies the Contracting Officer of successful performance.

- Inspection is performed using a variety of methods:
  - Tracking on a system such as the DoD's Contracting Officer's Representative Tool (CORT)
  - Completing forms such as the GS Form 220
  - Other memos and letters.

Step 8 – Pain Points

- Depending on the type of acquisition, a formal debriefing or debriefing-like narrative must be provided to the (successful and unsuccessful) offerors upon request. If these documents are not prepared correctly/carefully, this could increase the risk of protest.

Step 8 – Smart Contracts Benefits

Accuracy

Step 9 – Pain Points

- COR duties are often to those who are newly trained and lack oversight experience. This may result in:
  - Not tracking deliverables properly
  - Issuing out-of-scope directives without proper authority
  - Delays in inspecting/accepting supplies/services due to:
    - Systems access issues
    - Failure to track delivery or invoicing.

Step 9 – Smart Contracts Benefits

Autonomy   **Backup**   **Accuracy**

Source: MITRE

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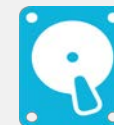
Contract Payment

Contracting Office - Step 10
CONTRACT PAYMENT

- Depending on the delegated authority, payment may be authorized by either the KO or the COR.

- Additionally, incremental payments may be made if the terms of the contract/order allow.

- Payment is usually processed through an agency payment system, such as DoD's Invoice, Receipt, Acceptance, and Property Transfer (IRAPT) System. The process steps are normally as follows:

  - The Vendor submits the invoice and inspection form in IRAPT.

  - The COR reviews both documents for sufficiency within seven days of submittal.

  - If the COR agrees with the vendor, he/she approves both documents. This approval automatically transmits to DFAS for payment IAW the Prompt Payment Act.

  - If the COR disagrees, he/she disapproves the documents, and the vendor receives a notice of disapproval.

Step 10 – Pain Points

- If inspections/acceptance forms are not filled out correctly, invoice may sit without action for extended time.

- If the Contractor's SAM registration is not current, this may interfere with electronic transfer of payment.

- Delays in timely inspection/acceptance/disbursement could result in an additional interest fee being owed to the Contractor.

Step 10 – Smart Contracts Benefits

Accuracy   **Speed**   **Safety**

Source: MITRE

MITRE

Contract Closeout

Contracting Office - Step 11
CONTRACT CLOSEOUT

- Once the KO has confirmed that all supplies/services have been rendered and all outstanding invoices have been paid, he/she initiates the contract close-out process.

- Depending on the complexity of the contract and the amount of undisbursed funds, the KO may send a letter to the vendor notifying them of his/her intent to close the contract. This letter requests the vendor to certify that there are no outstanding claims and that they agree that the contract is, in fact, completed.

- Once the vendor agrees and certifies the close-out letter, the KO closes out the contract electronically in the contract writing system.

Step 11 – Pain Points

- If a formal closeout is mandated, this often requires a closeout letter be sent to the Contractor, requiring them to certify that no outstanding balances or claims exist.

- Often, vendors are not responsive to this letter. There are occasions when this complicates the process:
  - The letter is sent to an old vendor POC who is no longer tracking closeout processes.
  - In cases when government closes out the contract based on the 30-day non-response time, there have been situations where the vendor later submits an invoice for a contract that has been closed.
  - Due to a high volume of workload and shortage of qualified acquisition personnel, closeout activities are often a low-priority task. As a result, the government regularly holds millions of dollars on contract that could otherwise be de-obligated and used for other government purposes. This results in money that is sitting there unused.

Step 11 – Smart Contracts Benefits

Backup   **Accuracy**   **Speed**   **Safety**

Source: MITRE

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