

CODIS: Combined DNA Index System



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he ability to compare DNA profiles worldwide has become increasingly vital to ensuring accuracy and fairness in criminal justice systems around the world and in identifying missing persons around the globe. Recovery efforts following the World Trade Center attacks, and the London and Madrid bombings, demonstrated the vital role DNA information can play in global security. And, forensic identification in mass fatality events is increasingly uncovering DNA matches for missing individuals from the former Yugoslavia (Bosnia/Herzegovina), the Thailand Tsunami and Hurricane Katrina.

With an accuracy of more than 99 percent, your DNA is responsible for transmitting unique hereditary characteristics that identify you alone. In identity testing, samples of DNA collected from blood, saliva, bones, teeth, hair or other tissues, provide a profile unique to each individual. In fact, DNA sequences vary tremendously from person to person, making it the most advanced and accurate method of testing available today for identification purposes. On any given day, there are as many as 100,000 active missing persons cases in the United States, and every year, tens of thousands of people vanish under suspicious circumstances. The Federal Bureau of Investigation (FBI) Laboratory's Combined DNA Index System (CODIS) blends forensic science and computer technology into an effective tool for solving crime and finding lost loved ones.

The Combined DNA Index System (CODIS)

CODIS began as a pilot software project, serving 14 state and local laboratories. From its beginning, CODIS was intended to foster the exchange and comparison of forensic DNA evidence from violent crime and missing persons investigations. The DNA Identification Act of 1994 formalized the FBI's authority to establish a National DNA Index System (NDIS) for law enforcement purposes. Today, this NDIS database contains approximately 3.9 million offender profiles and 160,000 forensic profiles.

The CODIS application supports three levels: NDIS at the federal level, the State DNA Index, and the Local DNA Index, where most evidence is entered. NDIS is the highest level in the CODIS hierarchy, and enables laboratories participating at state, local and global levels to exchange and compare DNA profiles.

CODIS is presently installed at 176 state and federal laboratories from Rhode Island to Louisiana to California, including FBI laboratories, State Police laboratories, the U.S. Army Criminal Investigation Laboratory, and a laboratory in Puerto Rico. The FBI also provides CODIS software and enhancements to international law enforcement agencies in more than 50 international laboratories in over 25 countries, including Botswana, Chile, Croatia, Estonia, France, Greece, Norway and Spain. To date, CODIS has produced over 45,400 hits assisting more than 46,300 investigations.

TV Crime Drama Meets Unisys Reality

DNA matching has made great strides in helping the families of missing persons and keeping criminals off the streets. DNA identification methods, such as those featured in TV crime dramas domestically and internationally, have become more real-world and in-demand by law enforcers and forensic scientists than ever before.

Meeting this increasing demand for DNA matching and associated technologies is where Unisys comes in. Combine Unisys experience in high-volume transactional computing with the ability to facilitate a huge, high-speed search structure, add in key partners with unrivaled scientific expertise, along with a creative, thorough and indomitable account team — and you have a winning reality for all involved.

In October, the U.S. Department of Justice, Federal Bureau of Investigation awarded Unisys a contract for the development and deployment of the Next-Generation Combined DNA Index System (NGCODIS). The development contract has an estimated value beginning at \$12 million, and up to \$50 million, if fully exercised.

Partnering with the University of Tennessee, the University of Cincinnati, IBM, and iSYS LLC, the Unisys solution provides software development, deployment, and operations and maintenance (O&M) support to address the critical need for scalability and flexibility. It also employs a highly-sophisticated search engine technology to greatly accelerate DNA matching, while continuing to be adaptable to changing legislative pressures with regard to DNA sampling, privacy, and the controversy of wrongful incarceration or prosecution.

The Value of Starting Early

Winning this project wasn't luck. As Bob Bratt, Justice & Treasury Cluster Partner, Unisys Federal Systems maintains, it was the result of starting early and staying diligent. "We started well before the Request for Proposal (RFP) was on the horizon, and we developed a solution well before the RFP came out. But most important, we were diligent in the continued evaluation of the bid as we went through every step of the process," maintains Bratt.

Research, comprehensive planning, and good opportunity assessment began nearly three full years before the RFP. Originally, CODIS was a sleeper, not showing up in any of the regular government procurement opportunities list. Thanks to an industry contact, Bratt was alerted early and began to look seriously at CODIS.

A large part of starting early meant understanding the environment and understanding the customer. Nearly two years prior to the formal opportunity, account team members attended a CODIS users conference and quickly determined the need for a forensic DNA subject matter expert (SME) if Unisys was to be positioned as a credible competitor.

Getting the Team Right

"A critical part of this was looking at the science and the people working in the science around DNA — the small companies working in DNA, the universities doing DNA research, and the entire political environment," said Bratt. "Identifying the leading people in this country talking about DNA research, we looked at scholarly writings, at speeches, and tried to unearth the limited references from the FBI.

"The number of people that understood it, and could evaluate and assist us in developing the solution was very limited," Bratt continued. "As the FBI was looking to innovate, we had to find the experts who were the innovators in the field." Account team members identified and met with the University of Tennessee's (UT) two leading authorities on DNA and convinced UT to join team Unisys. The account team also went to a recognized missing persons DNA expert at the University of Cincinnati and convinced him to serve as SME and technical advisor on an advanced analysis algorithm that accurately ranks matches between unidentified human remains and biological relatives.

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"Another key aspect of this had to do with the subcontractor partners we picked," mentioned Bratt with regard to iSYS. "We picked a partner that had worked in the incumbent's space, so our partner had extensive knowledge of the incumbent's present operation."

To round out the team, hiring key positions became critical. The team gained insight into the bid by hiring a domain expert away from the incumbent's staff. Then, followed with interviews of more than 20 candidates before they found the perfect project manager.

Another critical component of the team was One Unisys. "We were able to apply all the capabilities we have at Unisys in a variety of ways," said Bratt. Global Outsourcing and Infrastructure Services (GOIS) provided the help desk component and the O&M component of the bid. "The GOIS folks, their experience and their capabilities, helped to put forth a very compelling case.

"Systems & Technology (S&T) and the equipment we have — the high-volume computing power – was instrumental in taking the search engine and demonstrating the capacity, not only from a technology standpoint, but from an equipment standpoint as well.

"It was what Unisys could do for the FBI as a whole that got us to this bid. There's no one singular solution, these were multiple facets," said Bratt. "No one person makes a good team. It was multiple people that were contributing to it that made this a successful bid," he added.

What they have now is very cumbersome. It's a time consuming, high man-hour, intensive system. It needed to be simpler, easier, faster, better, cheaper — all the types of things you look for when you're overhauling a system **77**

The Customer and the Competition

With the same early drive, members of the account team attended several additional symposiums and CODIS conferences about a year before the RFP. This provided ample opportunity to understand more about the qualifications, and to meet customers and competitors. These meetings also enabled the team to employ good consultative selling skills to identify procurement strategy and key concerns with the program.

Early investigations concluded that while the current application worked, architecturally, CODIS had been built with a number of disjointed applications that proved unscalable. Other complications led to problems in the DNA identification system, particularly a lack of coordination among the four federal DNA databases, which included CODIS. With this upgrade, the FBI required a solution that was easy for users to navigate in their workstations. "What they have now is very cumbersome. It's a time consuming, high man-hour, intensive system. It needed to be simpler, easier, faster, better, cheaper — all the types of things you look for when you're overhauling a system," noted Bratt.

After speaking with the customer to register Unisys' early interest, the account team went on to identify incumbent weaknesses. The incumbent, SAIC, had the current contract for 15 years and appeared strong. But, the existing system's tightly-coupled architecture made it difficult for the application suite as a whole to take advantage of new processing and communications technologies. Modules had been developed separately with different programming languages which limited commonality among applications. In addition, there was no single interface to expose all CODIS functionality which complicated workflows, and search processing was limited by workstation hardware and servers.

In looking at the competition, the Unisys team also discovered other potential bidders. A formidable competitor, Lockheed Martin, teamed with Genecode, and eventually made it to the final stage of the proposal.



Building the Solution

About 18 months before the RFP release, the team began to hold Win Strategy Sessions with key subcontractors. Having identified the client's hot buttons, they developed win themes, further analyzed the competition, and started preliminary solutioning.

"All the research we did on this solution created the framework for what we ended up bidding," said Bratt. The team created an aggressive schedule to address as many legacy CODIS deficiencies and new features as possible within year one of development.

"At the heart of the solution, and what the FBI needed most, was a search engine infinite times faster then the existing search engine," maintained Bratt. The existing search engine was slow — some searches took hours, many hours, some took days. The FBI wanted to perform the same searches in minutes, in seconds.

That search solution was found in a product developed at UT in conjunction with the FBI. It had been developed, but never used. To ensure the search engine's speed and performance, the Unisys team did benchmarking. "We paid for it out of our bid budget, because we wanted to prove the search engine performed at a certain level," said Bratt.

The search solution infrastructure the FBI will get is at least twice as fast, maybe faster. The new search engine was benchmarked for peak performance on the Unisys ES7000 server — which potentially could translate to significant demand for the ES7000, as not only the FBI, but individual states, localities and other countries begin to evaluate the CODIS upgrade demands on their servers.

Also critical to the FBI was the ability for continued add-ons, enabling additional functionality as the political climate changed. The Unisys solution met the challenge by providing an architecture that's quick and simple to learn and easy to develop for. The new CODIS application is based on a Service Oriented Architecture (SOA)-capable communications infrastructure, focused on delivering reliable and secure communications both among CODIS labs and between client and server within a given lab. A Layered Architecture Approach was necessary to assure high availability of services, as well as to achieve loosely-coupled architecture, enabling separate applications layers to be hosted on physically different servers customized to the specific needs of the layer. The architecture focuses on a clean separation between user interface, application logic, and data.

This clean separation allows the CODIS development team to change an implementation on one layer without affecting the other layers. For example, changing the database vendor without having to change the business logic code. The solution also put everything in one place, creating a single interface to all CODIS functionality. This separation of responsibility within a single interface was critical to providing an extensible and highly maintainable system.

CODIS Procurement Cycle

Preparation for Winning Began Well Before RFP Release

 First time CODIS appeared on radar Not yet shown on usual Federal procurement lists Began holding Win Strategy Sessic on client's hot butto conducting compet analysis 		sions ttons, etition	 Signed UT and U of C to exclusive teaming agreements Funded UT to test search engine performance on ES7000 and port search engine to run on MS-Windows environment 		 Request for proposal released 18 May Proposal turnaround time 30 days Very complex proposal 1,500 requirements Government-provided pricing templates Proposal followed up by oral presentations 2 weeks later 		
3 years prior	2 years prior	18 months prior	1 year prior	6 months prior	3 months prior	RFP Released	RFP Awarded
	 Began attending CODIS User Conferences Account team introductions to CODIS community, including FBI CODIS Unit 		 Identified ex-CODIS project manager (PM) and company as potential teaming partner Identified need for SME and potential candidates from University of Tennessee (UT) and University of Cincinnati (U of C) 		 During last 6 months, secured key personnel for PM and CODIS domain expert positions Held Win Strategy Sessions with the whole team and completed preliminary solution 		Unisys awarded contract by FBI for development and deployment of Next-Generation Combined DNA Index System

The Bid Process and Blueprinting

"As we went through each week and each month of developing the CODIS bid, we continued to evaluate against the key factors in winning the bid and continued to improve upon them. At the very beginning of the bid, many things were weak, weren't fully thought out or developed yet," noted Bratt.

"But by the time we got within three or four months of the RFP, the story was crisp, our solution was ready to go, our people, including our project manager, were in place," he said. "That continued evaluation in building a better bid is something we did and I know it was absolutely critical to why we won this bid." Another element in building a better bid is the bid process itself — the Technical Evaluation Team (TET) review and Blueprinting process. As a matter of course, the Federal team goes through TET review with large bids, mapping the requirements to ensure they're costed through the bid. "The TET review was critical because this was a very large opportunity with a lot of lines in it, a lot of different moving parts, and a lot of requirements," Bratt noted.

The account team worked closely with the TET team to develop critical Blueprinting artifacts during the proposal. Creating these artifacts was an up-front investment in the project, intended to reduce risk and startup effort at project kickoff, which has paid off. Using Unisys recommended Blueprinting Tools helped the team gain better understanding of the proposal elements and enhance their ability to critically evaluate the entire proposal package.

Confluence of Unisys Competencies Offer Unique Value for CODIS

Secure Business Operations

- DNA search & match accuracy
- SOA capable infrastructure
- Reliable, secure communications among labs
- ID Missing persons

High Performance

- Scalability flexibility via alignment
- High availability in complex computing environment
- Price performance

Innovation

- University partners
- Advanced analysis and scientific innovation
- Sophisticated search engine capability
- Next-gen workstation design

Tracing requirements to the solution, to the proposal, and all the way to the cost build-up provided the team with complete cost fidelity. "We could trace the costs of every individual component of the solution. This provided us with a complete cost estimate and understandable cost justifications, and that ultimately helped us win. All because we had the right cost for the client's requirements, no more, no less, thanks to Blueprinting," noted Bratt.

Differentiator: Real Time Infrastructure

Differentiator: Open Source

Differentiator: 3D Blueprinting

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Key Bid Evaluation Criteria

The Federal Systems team has developed a simple model for evaluating bids, including six key factors. Continuous evaluation during the bid process breeds success, but it's essential to have at least some good answers to questions at the earliest stage — preferably well before an RFP is issued.

1. Past Qualifications:

- Can we do the work? What is our track record in doing similar type of work? Can we reference that work?
- Why is it that we want to bid? Can we prime it?
- What is the level of expertise of Unisys or proposed teaming partners?

2. People:

- Who are the key people?
- Who is to be the PM? Does he/she have the seasoned experience and the business/political acumen to deal successfully with the client (not a technical issue)
- What do they bring to the table?
- Degree of experience?
- How specific to requirements being bid?

3. Technical:

- What are our technical resources?
- What do we know about the technical solution? Do we have one?
- Do we know the client's "hot buttons"?

4. Price:

- Can we be cost effective enough to be competitive?
- Low cost is not necessarily the answer each time (don't undercut ourselves)
- Can we lower our price by using lower-cost labor pools?

5. Relationships:

- Do you know customer?
- Does customer know you?
- How much quality contact with customer is possible before the RFP is issued? Can we help shape the RFP?

6. Ability to Win:

- Is there an incumbent? Why can we beat them?
- Why would the government switch to a new contractor?
- Do we understand the Concept of Operations?
- Do we understand what the client wants/needs?

Winning and Implementing

Throughout the years of work, the nights and weekends, and the 300-page bid, the team stayed focused. They were creative, fearless, thorough and indomitable, knowing anything less would not have won the contract. "I knew the team had worked extremely hard in researching this, in developing the bid, in costing the bid, and I felt very comfortable that we had gotten it right," reflected Bratt.

Yet after the submission, work didn't stop. It continued as if the contract had been awarded. Faced with extremely short ramp up times, and a rigorous deliverables schedule — first deliverables due at the project kick-off meeting with client, nine major deliverable due 30 days after award, and 11 more 60 days after award — the account team took inventory, made preliminary calls, and ensured that people would be ready once the award came.

And it did. The team's "external obsession" won out. According to the FBI, Unisys won because of its clearly superior technological solution and its price. Blueprinting during the bid process made a critical difference in getting the price to fit the solution. Blueprinting called for the 1,500 client requirements to be mapped to Work Breakdown Structure (WBS) Level 6. The government also provided pricing templates, for which pricing had to be mapped to Level 6 of WBS. "Despite the challenge of governmentprovided pricing forms," Bratt continued, "Blueprinting and the TET review helped us get to a bid that offered the lowest price for a solution that was given the highest technical score in the client's overall rating."

In September, the Unisys team delivered the first live software, and the client is extremely excited about what they've seen to date. Right now the team is deploying the first phase of the solution, the missing persons analysis. Then they'll go to work on replacing the search engine.

"So far, they're extremely pleased with the Unisys progress," reported Bratt. "The senior officials at the FBI, the CIO included, recognize how Unisys has delivered first and foremost."

"And we absolutely wowed the crowd," said Bratt, describing a workstation demonstration at a user conference a few months ago. "Unisys has really hit the ball out of the park so far."

"When we ultimately deploy the search engine, they're going to have a whole lot less downtime, and be able to see immediate productivity gains across the board," said Bratt. "And they'll be able to see their backlog reduced. In this year's FBI budget, one of the key initiatives identified and funded was backlog reduction. At the heart of the reduction will be the Unisys solution."

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In addition to the initial contract, the team has already seen new business from the bid in the first year. The FBI has increased project scope, increased the technical resources on the project, and funded the O&M contract two years early.

For the future, CODIS translates to the ability to do additional work in the DNA field. "The domestic and international prospects for expanding our work leveraging CODIS are huge. We can market to every state and to other countries around the globe and build off of this position. We now have Unisys experts working in everything from the science involving DNA to setting up and running a sophisticated application which can match DNA specimens. Unisys now will become one of the foremost, if not the foremost, systems integrator in the world as far DNA solutions go," commented Bratt.

Ultimately, this new CODIS capability will mean "more" to many. More business for Unisys, of course. But, also more security on our streets, more answers after tragedy, more happy endings for missing people and more peace of mind for millions of people around the world.

Lessons Learned

Three key lessons were learned in the three plus years of working CODIS. First and foremost, get in early. "I believe all the preparation, not only for the bid, but since we've won the bid, will help if we start to hit bumps in deploying this," maintains Bratt. All the up front work has allowed the 40-person team to ramp up in just four months, allowed nearly \$1 million in hardware to be purchased for infrastructure and setup, and most importantly, enabled Unisys to meet every major deliverable date in the first year.

The second lesson is to understand who can help you win and to bring them in to build a first-class team. The combination of Unisys capability, renowned experts and scientists, and an incredibly dedicated staff have developed a first-rate product. "Through Unisys support, we've backed up that team and, where necessary, we've added additional resources to insure we continue to be successful," concluded Bratt.

Last, and perhaps most critical, maintain the focus and drive to win. Complex projects require dedication and drive, and an ability to see the mission-critical nature of what Unisys can do.

For the families and friends of the 100,000 people missing in the United States each day, DNA testing offers hope in the quest to finding answers. For the FBI, the success of the CODIS program will be measured by the crimes it helps to solve.

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Building on the Base

What has been done since the award on NGCODIS to increase revenue? The Federal Team has been busy listening to their customer, asking questions and understanding how compelling events and political implications may impact their client's operations.

Engineering Services CLIN

- This CLIN is exercisable at the discretion of the FBI to cover additional development or other related work not currently covered under the initial award. This CLIN was exercised in December (three months after the initial award) for a total of \$600k in services for the FBI
- Additional IBM training services award for \$30k
- Additional COTS CLIN award for \$300k
- Hardware refresh for 175 labs undetermined at this time

Software Development and Customer Satisfaction

- Early activation of the O&M services CLIN for support of the 9 labs that will be deployed in the first year (175 labs to follow)
- User Interface Experience Demonstrations
- There have been 2 demonstrations to the user community based on the iterations of the software that are available to demo. Each demonstration went extremely well with positive feedback from all members of the integrated product team
- The client felt it necessary to show an advanced demo to the user community at the State Administrators Users Conference in Las Vegas in May, which was not originally planned
- Client satisfaction overall is extremely high on the work performed to date

Long-Term

- Transition Plan for O&M service contract to Unisys
- Need to ensure no disruption to current production environment and balance full schedule until full delivery
- Leverage existing relationships with former colleagues and associates for possible teaming arrangements
- Leverage existing knowledge and contacts for U.S. Department of State and U.S. Department of Homeland Security

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