

**2022 NASCIO Award Submission**  
**State of Tennessee: Department of Finance & Administration**  
**Strategic Technology Solutions Division**

**State of Tennessee Infrastructure and Application Modernization:**  
**TCSES Mainframe Re-Platform and Conversion Project**



**NASCIO Award Category: Business Process Innovation**

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## Background

Strategic Technology Solutions (STS) serves as the State of Tennessee’s centralized information technology organization; our mission is to deliver business-driven technology solutions and services that best support state government in providing value for our citizens. We believe that in order to best meet modern challenges and sustain the pace of digital innovation, public-sector business and IT leaders must link critical strategic priorities with continued investment in technology and information. Accordingly, each year STS defines a new group of strategic initiatives designed to improve service delivery, modernize infrastructure and applications, and gain efficiencies.

## Strategic Alignment

Infrastructure and Modernization was named a major STS Strategic Initiative for 2021-2022, selected to improve enterprise effectiveness and efficiencies. The STS Infrastructure and Modernization initiative considers the various business and mission strategies across Tennessee’s 23 Executive Branch Departments and is designed to enhance and enable those strategies. This initiative underpins enabling technologies and capabilities within all of the other STS Strategic Initiatives (see Figure A), particularly for enterprise Cloud-readiness and cybersecurity.

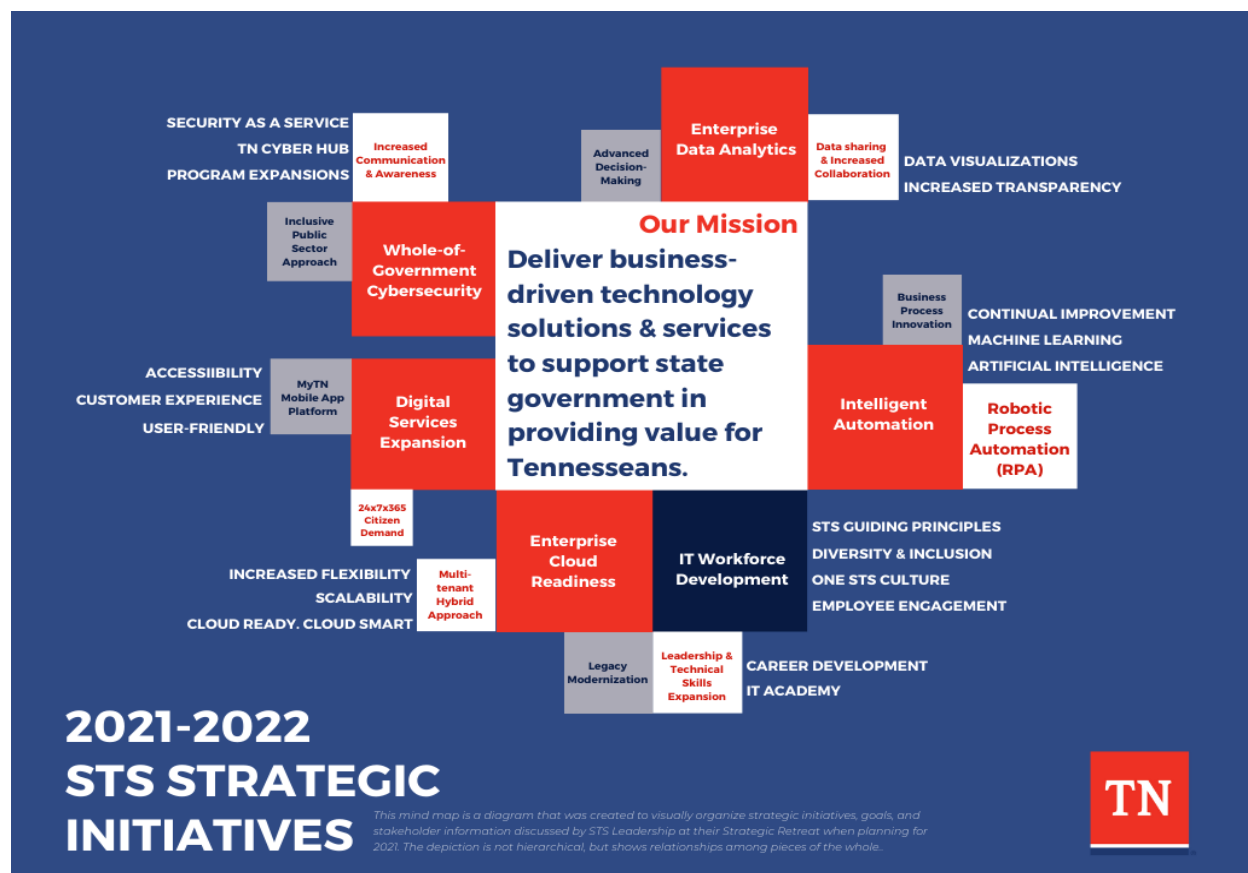


Figure A: STS Strategic Mind Map

Projects that fall within the Infrastructure and Modernization Initiative improve effectiveness, create fiscal efficiencies, and provide the right level of security to our state systems and data. As projects are completed, a fundamental shift in service delivery is beginning to occur at the State of Tennessee. STS has identified many benefits such as: a reduction in the amount of physical infrastructure needed to support Departmental missions, the removal of many artificial barriers to collaboration, and the creation of a model environment within the public-sector industry.

### **Legacy Modernization**

A significant part of the State of Tennessee's modernization effort is the overall goal of eliminating the need for all outsourced mainframe-related services and applications by June 30, 2024. Tennessee business applications running on the mainframe encompass the core of their Departments' workload, but at a detriment to sustainability and cost savings. There is increased demand for scarce mainframe-experienced resources available to assist state entities with decommissioning applications and data, which means private companies are able to charge a premium for their mainframe services. STS aims to continue reducing these legacy resource needs and dependencies by leveraging Cloud environments when updating the State's business applications – where appropriate.

Over the past two years, there have been only a few Departments with business applications remaining on the outsourced mainframe – which may make dependency appear minimal at first glance. However, because these applications are very large and complex their mainframe consumption amounts are typically massive. Moving a major application off the mainframe can be a large lift, but if done properly it will result in significant reductions in consumption, costs, and security risks. Reducing our mainframe dependency delivers foundational improvements for the enterprise such as lessening the cost of IT infrastructure, reducing the need for legacy-niche resources, and vastly improving the speed/flexibility of state operations. The Department of Human Services recently took a big leap off the mainframe with their 25-year-old legacy application because the outdated technology was hampering integration with enterprise shared services. These issues were limiting and delaying the progression of DHS's overall Modernization Strategy.

### **TCSSES Re-Platform and Conversion Project**

In 2021, STS and the Tennessee Department of Human Services (DHS) successfully completed a major re-platform and conversion project, moving the DHS Tennessee Child Support Enforcement System (TCSSES) off the outsourced mainframe. The TCSSES Re-platform and Conversion Project was a big win for Tennessee, because TCSSES accounted for 45% of the state's mainframe usage consumption.

The TCSSES project was highly complex in its delivery because of how critical the application is to state business operations. In Tennessee, the Department of Human Services administers the Child Support program with services provided by local district attorneys, DHS staff, and private agencies under contract through its 48 child support offices. There are over 40 technical staff members, 70 interface partners, and 3,000 end-users that leverage Tennessee's child support system to deliver these services. Child Support for Tennessee collects and distributes \$675M+ dollars a year.

Understandably, DHS stressed that they desired no impact to child support functions, reporting, or processes to occur during the project. The project team, made up of STS / DHS and Deloitte subject matter experts took this to heart, and they focused on defining a modernization approach that didn't encumber the workers interfacing with the application during and after implementation. Also, this was DHS' first cloud-hosted large application project, and the project team was therefore doubly

dedicated to ensure its success -- from procurement to the establishment of 6 unique application environments, then go-live. The team knew that thorough planning and comprehensive testing were going to be key for this project's success.

### **Project Planning and Implementation**

These overarching strategic considerations guided the project team's strategy and implementation roadmap:

- Meet business and stakeholder needs, ensuring the converted solution is focused on what both the State and the Department need/want.
- Manage financial and schedule impacts by balancing needs/requirements with cost-effectiveness.
- Focus on vendor management and project management.
- Maintain a cohesive user experience when converting the old application to the new platform.
- Ensure consistent communication; prioritize partnerships and collaboration.
- Reduce security risks and system instability associated with mainframe technology.
- Produce a flexible system that can evolve with future requirements and/or mandated functionality.

The project team partnered to deliver a solution to migrate the TCSES application from its legacy mainframe environment (z/OS, COBOL, CA Gen, Easytrieve, JCL, etc.) to a new Linux operating system, new Java code, and a modernized Cloud infrastructure. Using the automated Application Modernization Transformation solution powered by innoWake™, TCSES was migrated from the legacy mainframe to the Linux platform in the cloud while keeping 1:1 equivalence for code and functionality. The code conversion from CAGen Cobol to JAVA involved:

- |                              |                            |
|------------------------------|----------------------------|
| • 2,795 CA Gen action blocks | 741 CA Gen procedure steps |
| • 390 online screens         | 1,707 COBOL modules        |
| • 78 Easytrieve modules      | 720 JCL modules            |
| • 34 Utilities               | 49 QMF batch calls         |
| • 439 DB2 tables             | 1.2 TB data                |
| • 7276 Datasets              | 75 Interfaces              |

In parallel, the data was migrated from IBM mainframe DB2 to Linux DB2 database in AWS. This method allowed for the preservation of the business processes, the integration of the existing interface partners, and the retention of the end-user experience. Additionally, integration with enterprise services for address validation and identity and access management was done.

The project team managed a huge learning curve with this project being their first Cloud-based application hosting approach. The TCSES Cloud platform required:

- Establishment of a primary virtual private Cloud and a secondary private Cloud
- Establishment of 6 Child Support environments for operations and maintenance
- Establishment of Disaster Recovery and failover capability
- Establishment of Identity and Assessment Management for Cloud-based access and security
- Establishment of secure and encrypted transport of Federal Tax Information
- Establishment of a Services Layer for address validation and other key component services
- Establishment of DevOps (tools and process) for new Development Lifecycle
- The upgrade of network connectivity for Child Support Offices throughout the State.

They built-out environments within Amazon Web Service (AWS) Cloud to host the re-platformed TCSES application including online, batch, and data; automated processes migrated workloads to AWS without interrupting the existing legacy systems. AWS Cloud services (including AWS Direct Connect, AWS Transit Gateway, Amazon VPC, Amazon S3, Amazon S3 Glacier, Amazon EBS, Amazon EFS, Amazon CloudWatch, AWS KMS, AWS Lambda, Amazon SNS, AWS Systems Manager and AWS CloudTrail) were set up as part of this project. Additionally, TCSES disaster recovery was designed to leverage multiple AZs within a region to deliver the Recovery Time Objective (RTO) and Recovery Point Objective (RPO) requirements.

System Integration testing involved over 200+ jobs tested in parallel, involving 10+ schedules and covering over 250 test case scenarios. Testing involved validating job runs, data comparisons, and analysis on defects and solutions. While testing, the team found differences in how DB2 (Data Base Management System) performed differently when compared between the mainframe and Linux based DB2. The differences required unexpected changes be made to established database queries. The work required detailed analysis on over 670 queries and changes to 95 programs, including 228 SQL statements. It is important to note, these queries often changed the financial calculation of collections and distributions, and therefore accuracy to the penny was critical.

All of this work was scheduled and completed without impacting the in-progress SIT testing or disruption to 70 interface partners. With AWS Cloud, TDHS now has the flexibility to adjust capacity infrastructure and storage at the click of a button. Amazon CloudWatch allows TDHS to monitor the health of the servers, set up alerts and proactively adjust as needed.

To fully vet and verify the system, DHS end-users completed User Acceptance Testing (UAT) before the project team moved the application fully to the production environment. UAT followed the same parallel testing methods and were setup with an emphasis on online testing with batch processing. During UAT a total of 156 tickets were logged, reviewed, and resolved. This process involved over 700 test cases and required the validation of data and print for local and centralized distribution.

Once all application testing was complete, the project team focused on business user training and a pilot implementation. Onboarding and training were completed for all 3,000 end users across 48 Child Support offices. After testing and training was complete, making adjustments to ensure appropriate network capacity was the final item that was addressed. With “all systems go”, the official statewide rollout of the Tennessee Child Support System, hosted in Amazon Web Service with refactored code, took place on July 7<sup>th</sup>, 2021. The re-platformed TCSES system rollout occurred without incident or negative impact to DHS Child Support, which was very important to DHS.

### **Departmental Impact**

The TCSES conversion and re-platform project has positioned the Department of Human Services to further progress its overall modernization strategy – especially considering all the technological benefits that are now possible:

- Expedited development cycles and stable releasability with the implementation of DevOps tools and processes.
- Created the ability to assess real-time infrastructure health metrics, alerts, and audit logs all in one place with Splunk monitoring & dashboards.

- Made available the means to leverage infrastructure capacity on-demand for use of only what is needed.
- Created potential to incrementally modernize the TCSES application and to integrate with state-wide shared services and technologies based on Departmental priorities.

**Enterprise Impact**

This two-and-a-half-year project was a major component of the enterprise strategy of reducing the State’s dependency on the outsourced mainframe, and it greatly increased the adoption of Cloud compute. After TCSES re-platform, Tennessee’s usage consumption went from approximately 1,000 MIPs (Nov 2020) to 400 MIPs (Nov 2021) used per month, which equates to a ~45% decrease! There are financial benefits associated with this project, as the State is charged by usage consumption on the IBM mainframe. The drop in MIPs resulted in a ~63.5% decrease in billing for DHS mainframe consumption charges.

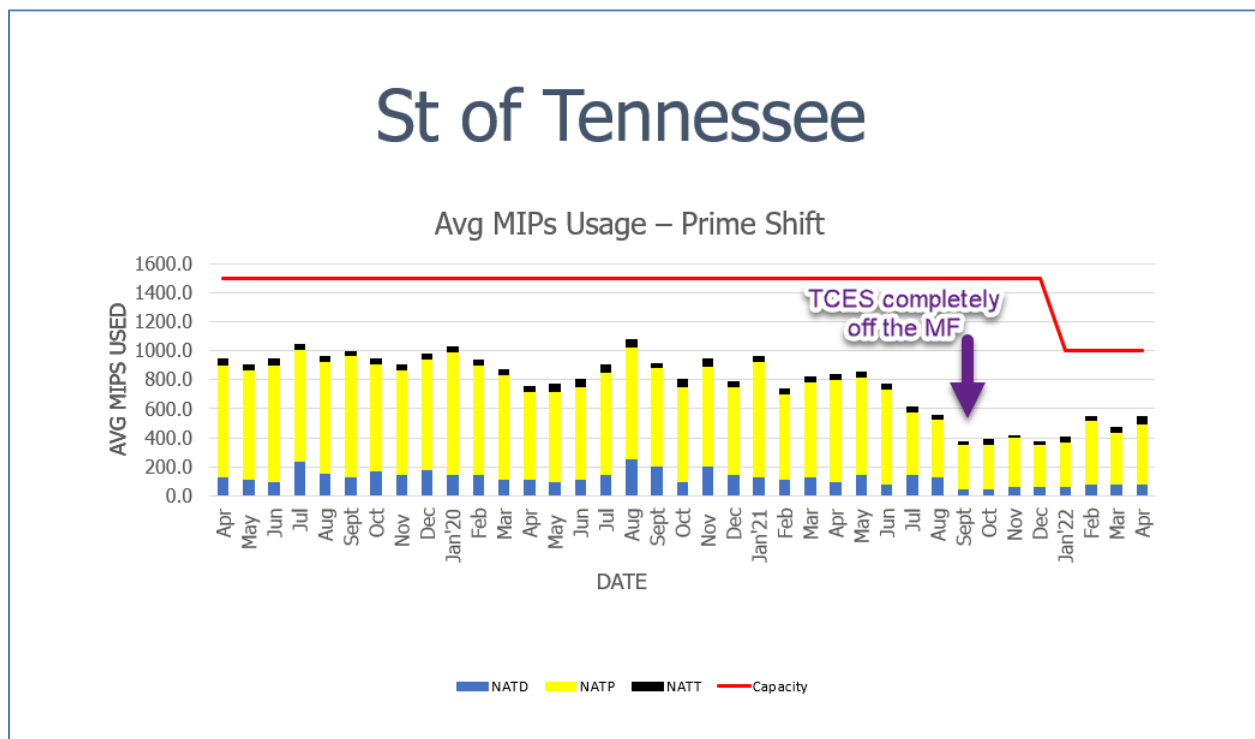


Figure B: State of Tennessee - Average Consumption on IBM Mainframe

The TCSES Re-Platform and Conversion project has also improved the State’s overall cybersecurity posture. Hackers are becoming increasingly sophisticated in targeting mainframe vulnerabilities for exploitation and data theft. This is because most mainframe applications were custom-built and written in obsolete programming languages. Mainframe environments don’t see the same level of security monitoring and detection compared to the advanced cybersecurity tools that are designed for Cloud environments, such as encryption and data protection, multifactor authentication, and more robust password management. In moving TCSES off the mainframe and into the AWS Cloud, the State of Tennessee is able to better protect Child Support constituent data and further reduce risk of threat penetration to the state network (see Figure C).

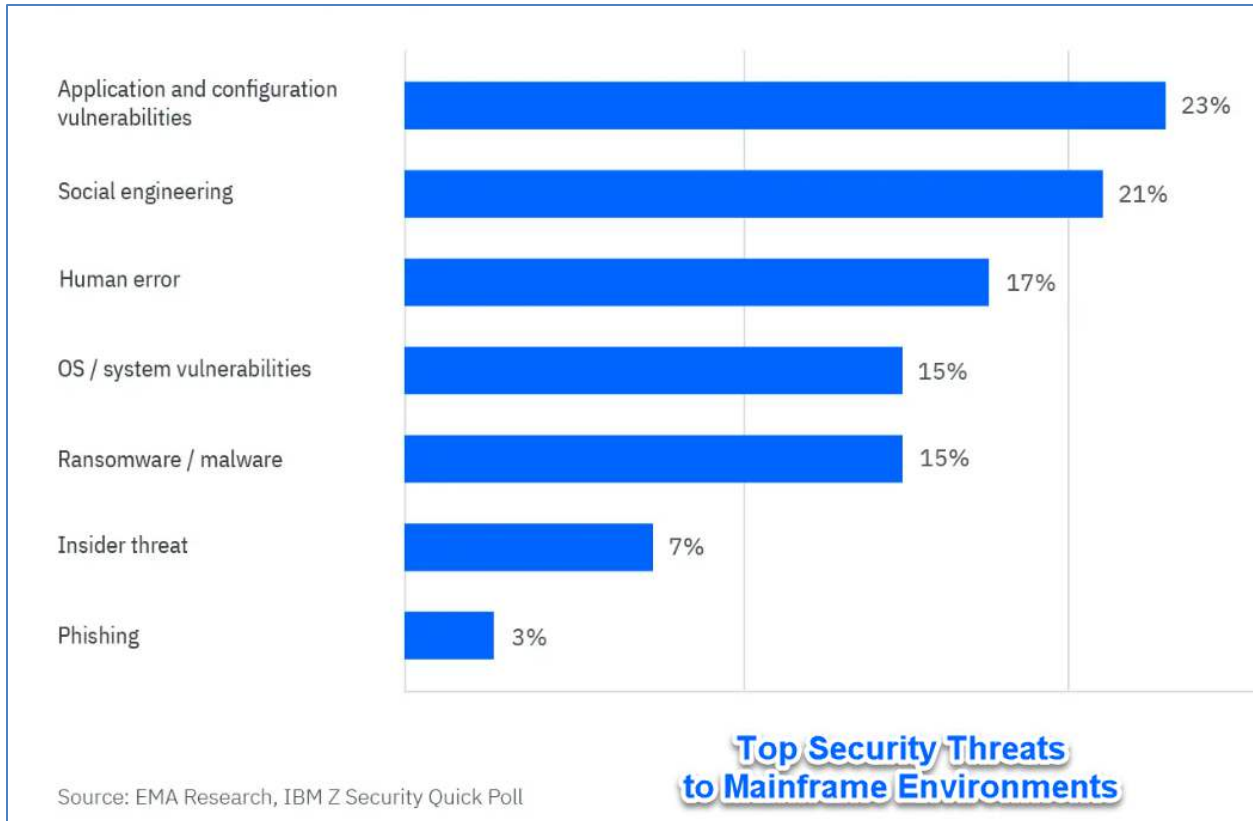


Figure C: Mainframe Security Threats

**Conclusion**

Overall, this project optimized the way that DHS Child Support processes and technology work together to provide essential government service to Tennesseans. It provided greater capabilities for service delivery collaboration, improved cybersecurity posture, expanded the state’s Cloud footprint, and resulted in cost saving and cost avoidance. The State of Tennessee has even received industry recognition at the 2021 AWS Invent Conference, where Deloitte highlighted the success of the DHS TCSES Re-platform and Conversion Project.