Improving America's Voting System with Enterprise Architecture Practices

for

ICT-4010 Enterprise Architecture

Master of Science

Information Systems Security

Ty Dockter

University of Denver University College

November 10, 2019

Faculty: Steven Else, PhD

Director: Thomas Tierney, PhD

Dean: Michael McGuire, ML

Executive Summary

One of the fundamental aspects to American governance is the American voting system. Our elections are crucial for enacting societal change that directly reflects the viewpoints of its citizenship. The individual state system that was originally conceived is becoming less effective in running elections in the age of the Internet. Cyber security concerns and other threats are impacting voter confidence and new advancements need to be worked towards for the registration process and vote casting procedures.

The infrastructure currently in place is aging at a pace that puts the entire system in jeopardy. The voting system also suffers from a lack of guidance and consistency, but the Election Assistance Commission has been recently established to help with funding and fill this gap. Improvements to the registration process, voting process, maintenance, and elements of the auditing and verification processes of the election need to be made to increase voter confidence and improve voter turnouts. Other issues in governance and scheduling also need consistency.

The TOGAF®[1] framework has been selected to align the architecture vision to the operation, data acquisition, applications, and technology layers used during an election and for registration. This framework is well suited for this large endeavor and provides an Architecture Development Method (ADM) cycle to map various areas of improvement. Flowcharts for various application improvements and a roadmap have also been developed to support these changes to the enterprise architecture.

[1] TOGAF is a registered trademark of The Open Group.

Table of Contents

Introduction 1
General Background 1
Architecture Vision/Purpose 2
Major Architecture Concerns 3
Analysis of Identified Architecture Issues 4
Nationwide Silos 4
Voter Registration Data 5
Voting Coordination 8
Minimal Application Standardization 8
Voter Education 10
Infrastructure 11
Recommended Solutions 13
Nationwide Silos 13
Voter Registration Data 14
Voter Coordination 15
Minimal Application Standardization 16
Voter Education 17
Infrastructure 18
High-Level Roadmap 20
Conclusion 21
Appendix 22
References 26

Introduction

General Background

Voting is fundamental to the democratic process. It is essential for electing government representatives, enacting laws federally and locally, and has been a part of American culture since its founding in 1776. “The idea that all eligible citizens should have an equal vote is deeply ingrained in the American consciousness. Yet the very meaning of this ideal is fiercely contested, as much so now as at any time in the last half century” (Tokaji 2018). Although the rules and regulations concerning the voting process and eligible voters has changed drastically over the years and decades since America’s founding, the basic premise will continue to remain the same in a democratic society. One thing that is always in constant flux, however, is the progress that American society continues to make and in the age of the Internet, there has never been more demand for a better conceived and fluid voting process to reduce or eliminate the dilution and denial of voting rights of various groups of people.

Despite the huge amount of money spent on campaign financing, election marketing for the individuals, measures placed on a ballot and the heavy emphasis placed on the importance of elections, the American voting systems and ballot casting technologies are drastically flawed. “In recent elections, about 60% of the voting eligible population votes during presidential election years, and about 40% votes during midterm elections” (FairVote 2019). The process is becoming increasingly more vulnerable to cyberattacks, lacks standardization across all participating voting states, is poorly coordinated, registration is cumbersome, and many voters are denied their voting rights because of bureaucratic and political impediments. These well-known and documented issues leave millions of Americans concerned for the system’s accuracy

and verifiability, others are uncertain if their votes even matter, and many millions are still unwilling to set aside the time to perform their civic duties because of these conflicting obstacles.

Architecture Vision/Purpose

The principles of Enterprise Architecture EA are perfectly suited for addressing, analyzing, and offering solutions to combat these growing electorate concerns to help make this process a better reflection of the will of the people. The voting system is currently operating on a diversification operating model with low integration and low standardization, but may benefit from adopting a unification operating model that has both high integration and high standardization. Taking this approach would ensure that the voting registration and ballot casting processes would remain the same across the United States instead of operating as separate entities at the state or county levels. To do this, improvements would need to be made at the operation, data/application, and technology layers of The Open Group Architecture Framework or TOGAF® model.

Success for the American voting system will directly correlate with increased voter turnout for both the presidential election years and the midterm elections as well as improved voter confidence amongst all age groups. There are existing metrics for both of these statistics that should be used to determine the effectiveness or failure of the adopted enterprise architecture approach. Success will also be determined by the simplification and ease of use for the voter registration process, fluidity of voter data between separate systems, validity of the voting system, and the ability for multiple means of verifiability and attestation on behalf of the voter.

Major Architecture Concerns

Nationwide Silos

- Each state, county, and individual polling place has separate laws and rules regarding polling stations, voting machines, poll watchers, and other aspects to ballot casting which makes the entire election process much more difficult to coordinate than it needs to be.

Voting Coordination

- No standard method for coordinating voting exists as each state can dictate how their elections are run.

Voter Registration Data

- Registration rules vary between states as well as required documentation, timing for required registration, crosschecking voter information, and purging practices which complicates the performance of these tasks.

Minimal Application Standardization

- Several voting systems use different data acquisition methods and have different interfaces that can be confusing to voters and make it difficult for them to verify that they are actually voting for who they think they, or what policy or law they are agreeing to.

Voter Education

- There are different requirements for voting between states as well as rules for polling places and casting votes that may not be adequately disseminated to the American voting population.

Infrastructure

- Voting systems and polling stations are dissimilar, aging, and are not adequately staffed with cyber security professionals, information technology personnel, or the necessary equipment to adequately establish properly networked information systems.

Analysis of Identified Architecture Issues

Nationwide Silos

Current state:

Governing Authority - Across the United States, there is no one governing authority on elections. Article 1 of the Constitution placed the responsibility of federal elections in the hands of the states and several amendments and voting rights laws have been passed to reduce discriminatory practices and provide assistance and accessibility for the disabled and the elderly. Two more recent laws have helped to establish some formal guidelines and assist with managing elections, but there are few federal requirements for how a state should conduct their elections or manage polling places. The National Voter Registration Act (NVRA) of 1993 has helped give voters better methods for registration and the Help America Vote Act (HAVA) of 2002 has allotted additional funding and created the U.S. Election Assistance Commission (EAC) (USA.GOV 2019). These laws do not dictate what states must do for elections and allow states to mostly govern themselves. Despite providing the ability to test, validate, and certify voting stations, it is not a requirement:

> "Thirty-eight states and the District of Columbia use some aspect of the federal testing and certification program in addition to state-specific testing and certification of systems… Four states refer to federal agencies or standards… Eight states have no

> federal testing or certification requirements. Statutes and/or regulations make no mention of any federal agency, certification program, laboratory, or standard; instead these states have state-specific processes to test and approve equipment" (Hubler 2018).

Along with this lack of federal requirement to certify and govern elections, anyone may recommend and volunteer a polling station. This is necessary to ensure that there are enough physical locations for voters to cast their ballots. When these polling places are forced to close or have accessibility issues, it gives credence to the argument for voter suppression tactics. Quite often, polling places may be garages or older buildings that are ill equipped to handle polling stations and lack the necessary connectivity to adequately accommodate these machines. Polling places are also not fixed and may change locations between election years as they are voluntary.

Polling Roles - Poll watchers are voluntary assignments and their qualifications are state governed. They are meant to provide transparency and ensure accurate vote casting and counting as well as proper polling practices and to report irregularities. Poll watchers may also introduce an intimidation variable to the voting process which may discourage voting. In most states, poll watchers are allowed to challenge voter identity and their right to vote. The number of poll watchers assigned per precinct or polling place is also determined by the state.

Voter Registration Data

Current state:

Voter PII - Voter registration databases house the personal identifiable information (PII) of every registered voter in America. This information is incredibly valuable and must be

properly protected with adequate encryption and authentication practices. Registration can occur in multiple ways. Citizens can fill a form out at a local election's office, register at the Department of Motor Vehicles (DMV), through a third-party organization for registration, or online. Several challenges exist in how/if the data is collected as well as how the registration transactions occur.

Separation and Additional Duties - Separate agencies govern the DMV and elections, each with their own missions. The NVRA does little to enforce cooperation between the two agencies and the DMV has little incentive to meet the added responsibility of registering voters. There is also no standard by which the DMV interacts with voter registration or how it collects data. "If the motor vehicle agency is collecting voter registration applications electronically, those data need to be compatible with the state's voter registration system" (Mann 2014). This is not always the case. In some states, registration occurs in one form and then is manually entered. This allows for human error to enter into the data collection and transmission process. Paper applications may also be used which are mailed either by the DMV or applicants are instructed to do so.

Aging Databases and Repositories - Several registration databases have been established since the early 2000s. Voter registration list maintenance is plagued by issues of its own. These databases are aging and may now have vulnerabilities that can be exploited by cyber criminals. These outdated systems also do not automatically share or cross-check voter registration information. Again, the maintenance of these databases and registration lists are determined by the state, however, "The NVRA does permit states to use uniform and non-discriminatory practices to ensure the accuracy of these lists, including using mechanisms to

check information across states" (EAC 2017). Different tools exist for preventing duplicate or illegitimate entries, but no single tool is required by all states. The Electronic Registration Information Center (ERIC) has 20 participating states and the District of Columbia, while the Interstate Crosscheck Program has 30. These tools are used to cross reference, "…voter list data, motor vehicle data, change of address data, and death records to keep voter rolls more accurate and up-to-date," (EAC 2017). This helps to prevent duplicate registrations or double voting. These tools are voluntary and not required by federal law. Felony records, death records, and property deeds also help to ensure database accuracy.

There are also different deadlines to register. Depending on the state, deadlines vary between 30 days before an election to election day. North Dakota is the only state that, "…does not require voter registration ahead of an election—eligible citizens can simply appear at the polls with required identification and be permitted to vote" (Root 2018). Not standardizing deadlines allows for voters moving between states to miss important registration deadlines, foregoing their ability to vote in an election. It is not always obvious which types of documents are necessary for registration or changes in voter information.

Voter Entry Issues and Voter Suppression - Other issues can occur with data entry and cause voter suppression or unintentional purging. If signatures on voting registration forms or applications do not match they can be voided. If names are spelled incorrectly or are input with errors, it can cause duplicates. Slight changes or abbreviations in addresses can also create duplicate entries or make it difficult to verify a voter which may unintentionally cause duplicates or purging. These issues can cause further discrepancies on voting day if deadlines have passed. For these situations, states offer conditional registration and provisional ballots,

but in some cases, it adds an additional step to a county election official.

Voting Coordination

Current State:

Voting Day and Early Voting - Because each state dictates how voting will occur, how polling places operate, how long the ability to cast a vote exists, and what methods may be used, there are differences across the electoral college. Some states offer a single day to vote while others allow for multiple early voting days, but this can vary widely between states and even counties. Because elections are always held on a Tuesday, this disproportionately effects the working classes and younger voters.

Online Voting and Mail-In Ballots - Not a single state offers the ability to cast a ballot online due to perceived security risks. Some states do offer the ability for mail-in ballots, but the specific requirements vary between states. Colorado, Oregon, and Washington are the only three states that offer all-mail voting along with Hawaii in 2020. "Every eligible voter is sent a ballot that can be returned by mail, or dropped off at a voter center or similar location during the early voting period" (Underhill 2019). There are additional states that allow some counties to participate in all mail ballots as well as some specific election types in other states. These states have very specific rules on which types of elections are permitted to use mail-in ballots.

Minimal Application Standardization

Current state:

Moving Away from Punch Ballots - Ballot counting across America is done in different ways on election days depending on the method by which a vote was cast. Luckily, punch ballots were last used in 2014 and no longer allow for hanging chads, or partial punches that do

not register as a vote. The issues that are occurring now are related to verifiability on behalf of the voter and the lack of adequate auditing after an election to ensure that what was counted as a vote in an election is an accurate reflection of the voter's intent.

Problematic Touchscreens - Touchscreens are often used on today's voting machines. These are relatively straightforward and mimic the activity millions of Americans do on a day-to-day basis with their smartphones. Despite assumed familiarity with the technology, user interface designs and sensitivity issues can still cause problems for voters. Some voting systems still do not have a paper printout for verification which makes verifying the choices a voter selected and auditing the vote tallies difficult or impossible. Even when paper ballot verification occurs, there is no requirement for auditing and most states do not verify electronic voting systems against the paper printouts.

Issues with UI - Some newer machines require a printout and verification by the user. The issues on these machines can be related to the user interface. Some machines have a requirement to push the same button twice to submit a vote - once for a print out for verification and again to submit. This is how these voting machines should be configured, but they should use different terminology to clarify verification and submission, as well as a screen acknowledging the casted vote. This lack of clarification can cause confusion and has resulted in some ballots being invalidated by poll workers. In several examples across the country, other issues are related to the user interface. The font can be too small or too large which impairs the ability for some voters to read the contents on the screen. Enlarging only exacerbates the problem and can move elements around in ways not intended or making the contents illegible. Crowding can cause some of the electoral contests to be missed or go unintentionally marked

for a vote. Other instances are related to sensitivity and large coats or sleeves might register a phantom screen press which results in a false registration of choice. This decreases voter confidence and makes them question their submission. Pressing too high or too low or too hard can cause issues as well. When voters are frustrated, they may press harder which can inadvertently result in more errors.

Voter Education

Current State:

Lack of Information or Resources Presented to the Voter - Very little is done to educate the American voter about the voting process. As the technologies change to cast a ballot and as rules differ between states, there is not always communication or knowledge transfer to familiarize the voter with these new systems or changes. If people are used to casting a ballot by punching a paper sheet and that method is suddenly eliminated, new methods may not be familiar to some voters. Suddenly requiring voters to shift from paper to touch screen is a large leap for some, and this can increase the time it takes to vote and can increase wait time. Registration differs between states so voters must actively seek out this information if they want to cast a ballot in the election or be eligible to vote in primaries. Paper pamphlets at election offices or the DMV may present this information, but in terms of educating the voter on the technology, that may come down to interaction with the equipment. No test machines are setup at polling places for this purpose. Specific requirements on the interface and print verification may not be obvious and votes may be invalidated as a result. No display screens at polling places are utilized to present this information or other information about the voting process.

Infrastructure

Current state:

Power concerns - Because anyone can recommend or offer a polling place, not all voluntary locations are adequately equipped to handle networked or e-voting machines. Power requirements can be an issue and without proper backups or uninterrupted power supply (UPS) systems, voting machines are vulnerable to electrical spikes and faults and unscheduled downtime and maintenance. In more rural locations, these problems can be exacerbated and voters may find themselves waiting in much longer queues than what they had originally planned. This can cause discontent, force some voters to leave, or some districts to resort to backup plans, but only if these risks were properly managed and planned ahead of time.

Aging Systems - Voting machines are also aging. "A Brennan Center for Justice survey this year found that 41 states are using systems that are at least a decade old, and officials in 33 states said they need to replace their systems by 2020, but many lack the funds to do so" (Editorial Board 2018). Aging infrastructure means that the machines may become increasingly vulnerable to hacking and manipulation as well as degradation, wear, and inoperability. It also means that aging software is more difficult to patch and repair parts for obsolete systems are becoming more difficult to locate.

Inadequate Training and Staffing - To add to the issue, poll workers are not properly trained to identify potential issues with voting machines from an information technology or information system risk management perspective. Polling places are also not properly staffed with information technology personnel or cyber security experts to identify vulnerabilities with their systems. The state must rely on the manufacturer of these machines and auditors to

discover issues before voters attempt to cast ballots, but several states do not require this. The training for poll workers is also not focused on identifying cyber security threats, but rather how to operate a polling place and how to assist voters with the mechanics of the UI, troubleshooting basic user created issues and functionality. There are election technology experts that do help maintain these systems, but they are not present at polling places during elections. Several issues have been detected and presented to election officials in various states, but not all of these discovered issues have been corrected.

Manual Asset Tracking - Manual methods are being used to track and inventory voting machine assets. These methods are prone to human errors, they are time consuming, and they make it difficult to predict future costs or schedule maintenance. They also rely heavily on spreadsheets that can be changed accidentally or intentionally by insider threats or malicious actors.

Vulnerable Websites for Displaying Polling Results - The websites used to present voting results to the public are also vulnerable. At Defcon 26 held in Las Vegas, Nevada, "…kids as young as 7 years old managed to manipulate replicas of election night results pages in key battleground states from 2016; pages built, organizers say, using actual vulnerabilities previously reported" (Albert 2018). These may not be the actual websites used to release voter tabulations to the public and the actual voting machines and system are not connected to any state's websites to show polling results, but it does demonstrate the ease with which webpages that present voting results to the public could be manipulated. This could cast voter doubts and raise questions regarding the actual election results which could stoke illegitimacy rumors and recounts which cost tax payer funds to be utilized for unnecessary verifications.

Recommended Solutions

Nationwide Silos

Proposed Solution:

With the passing of the HAVA of 2012, federal funding has been allocated to states and the EAC has been established. Because states now receive federal aid, this commission should be given proper authority to regulate elections across states and establish a set of requirements that each state must meet as a bare minimum to make elections across the United States fair and consistent, in order to increase voter confidence moving from a diversification operating model to a unification operating model. The commission produces guidelines to help with running elections, but enforcement should be mandated as part of federal funding. Anti-discriminatory practices are already in place and ADA requirements exist, however the following standardizations should also be implemented:

- Mandatory auditing and verification of voting systems.
- Power and network requirements for polling places along with stricter regulation for ADA accessibility considerations.
- Site visits to ensure polling places are adequate locations for voters.
- Consistency in poll worker training and resource materials.
- Up to the day voter registration, early voting, and vote by mail options.

Integration between states with a unified online voter registration database and a move towards online voting should be the ultimate goal. To accomplish this, enterprise architects should be assigned to each state with project managers across various cities and municipalities. The Web Oriented Architecture is much simpler and easier to get started than Service Oriented

Architecture and the online voting system should be built with this in mind. Each of the four architecture domains: operation, data, application, and technology layers should be addressed. Using the TOGAF® Architecture Development Method (ADM) cycle, the EAC can address various issues with the mission of the American voting system and how it goes about updating its operation, data, application, and technologies. Starting with Phase A, the architecture vision, and phases G and H, implementation governance and architecture change management, these improvements should be discussed and mapped for all iterative phases and analyzed after implementation.

Alternate Solutions:

In lieu of moving to a unification operating model, choosing a replication model instead might help to bring consistency to state run elections. Standardizing in the way previously described would allow states to remain on separate systems, but allow them to be consistent across the country.

Voter Registration Data

Proposed Solution:

Considering the operation layer, all states should allow for online voter registration to be performed by the individual voter if preferred. This should be aligned with the TOGAF® ADM and phase B, the operation (business) architecture. This reduces issues with data entry. Registration should be allowed up to the day of the election. All states should be mandated to use one standard tool for crosschecking voter information across state lines. Because of the complexities across the disparate systems, a simplified solution should be explored. States should be allowed to use additional tools as needed to improve accuracy of their databases.

DMV staff should no longer be required to perform this function, but public spaces like the DMV, libraries, and post offices should be utilized to allow those without personal or home web access the ability to use online registration portals. A use case diagram can be referenced in Appendix B. In all states, especially rural areas, mailing options should be available at these spaces. All states should be required to perform automatic registration and no state should be allowed to forego the registration process.

For the application layer, integration of databases should be explored and planned using the TOGAF® ADM cycle. A WOA should be developed to house these disparate systems so datasets remain consistent. If placed on a cloud environment, it would remove maintenance issues and potentially decrease the effects of aging systems. Phase C, D, and E, the information system architecture, the technology architecture, and the opportunities and solutions of the implementation should address these issues.

Alternate Solutions:

If integration is not the focus, then there should still be systems in place to verify voter information that are standardized across all states at a minimum. A move toward standardizing voter registration should be mandated so verification of the system and auditing can be performed. Mandatory life cycles should be enacted to reduce the chances of databases and equipment becoming outdated. These systems should be subjected to frequent auditing and verification.

Voter Coordination

Proposed Solution:

A standardized requirement for states to offer the exact same voting schedules with

early voting options would quickly and easily remedy most issues with confusing timelines and conflicting work situations. These schedules should be posted in public spaces and advertised with a portion of the allotted federal funding. Mail-in ballots should be required as an option in every state. These improvements will help eliminate issues with holding the national vote on a Tuesday. Online voting should be explored as a possible solution to increasing voter turnout. A timeline should be established to create a WOA for online voter registration and online vote submissions to allow for the most efficient means of registering, voting, verification, and auditing. These issues should be addressed in phases A-E as well.

Alternate Solutions:

Federal funding should allow for these changes to become requirement, but as many of these options should be explored as possible. If schedules cannot be synchronized and mail-in ballots are not an option, better communication by the states are needed to ensure the largest turnout by voters possible. Phone calls by volunteer forces and poll workers, video advertisements on television and web media, and transferring another holiday like Columbus Day to National Voting Day to allow for workers to have a holiday designated for voting or changing election day to a weekend would help to increase voter turnout.

Minimal Application Standardization

Proposed Solution:

Multiple companies are certified to create and maintain voting machines. These voting machines are proprietary and are configured with separate application structures and different technologies for printing verification, if at all. All voting machines should be required to print ballots for verification and auditing. A better solution should be worked towards with a federal

online voting system developed as a WOA (Appendix C). This system should utilize multifactor authentication (MFA) practices, encrypted connections, and have the ability to email a digital printout of voting results for verification. This system should tie into an online voter registration database. This database should also retain the voting record of every election.

By consolidating it into one system, a security operations center (SOC) could be dedicated to ensuring the security of American elections. Mail-In ballots, voting machines with print verification, and paper ballots should still be created and utilized for rural areas without Internet connections. This would drastically increase voter participation and reduce wait times and voter suppression at polling places. These considerations will map similarly to the ADM as the voter registration implementation with phases C-E.

Alternate Solutions:

If a unification operating model is not desired, then states should use federal funding to work towards their own, state-wide WOA system with individually established SOCs. These web portals should require the same basic functionality, MFA, and encryption practices, but would be controlled by the state instead of the federal government. These separate applications should have the same data requirements and tie back to one reporting system.

Voter Education

Proposed Solution:

Voters need better communication when it comes to changes in the voting machines with which they will interact. Moving from paper to touchscreens can be a major shift for some users. The UI also needs to be better tuned to ensure that voters know what is required of them to verify and cast ballots. These distinctions need to be apparent. While testing machines,

the elements of the contest need to be designed to accommodate poor sighted individuals or allow for the use of a paper printout with enlarged text that can be referenced along with the touchscreen. Backup solutions should be present with paper ballots. Electronic signage should be utilized where applicable to highlight changes and a test machine should be setup to allow voters to interact with the UI before voting so they can ask questions and orient themselves to what they will experience. There is no alternate solution, this knowledge dissemination is crucial and needs to be implemented to whatever extent possible. Not all locations can accommodate every element, but should attempt to offer as many of these solutions to reduce confusion and decrease wait times. The improvements will map to the G-H phases of the TOGAF® ADM.

Infrastructure

Proposed Solution:

All polling places need to be equipped with adequate power in order to be considered for polling with an electronic voting system. These systems need to have UPS attached to prevent issues caused by power failures. Paper backups need to be located in each polling place in case of power or application failures.

Aging systems are one of the biggest issues facing voting. All voting equipment should be placed on maintenance and life cycle schedules to prevent these machines from dragging the entire system down. As previously stated, online voting WOAs should be worked towards on a scheduled timeline to prevent replacement costs associated with voting machines. Manual methods for tracking assets should also be automated and third party or open source resources for tracking inventory should be explored to eliminate the time-consuming aspects of asset

tracking. Appendix D highlights the process flow diagram for inventory and maintenance tracking.

Polling workers should have access to communication tools and knowledge bases where they can pull up information about issues across all polling places and see what sorts of problems are occurring (see Appendix A.) Information technology staff need to be made available to polling stations with frequent visits by technicians. Polling workers need to be trained on the equipment to ensure their familiarity. These training programs should be created with a content management system to ensure consistency and certification for all polling workers and watchers.

All of these separate systems should be simplified and consolidated to allow for better management of the entire system. The current system is very manual and requires a massive volunteer force to run. Automating basic functionality would significantly improve the voting process and reduce the time it takes to cast votes. These implementations would map similarly to voter registration with phases C-E.

Alternate Solutions:

This system needs to evolve to become more effective. It is aging and because of this, replacement is necessary and should allow for improvements to be made periodically. Analysis should be conducted to determine which methods are the cheapest and most effective to implement. Mail-In ballots seem to improve voter turnout and allow citizens the ability to vote when they may not be able to due to work conflicts or required travel for polling places.

High-Level Roadmap

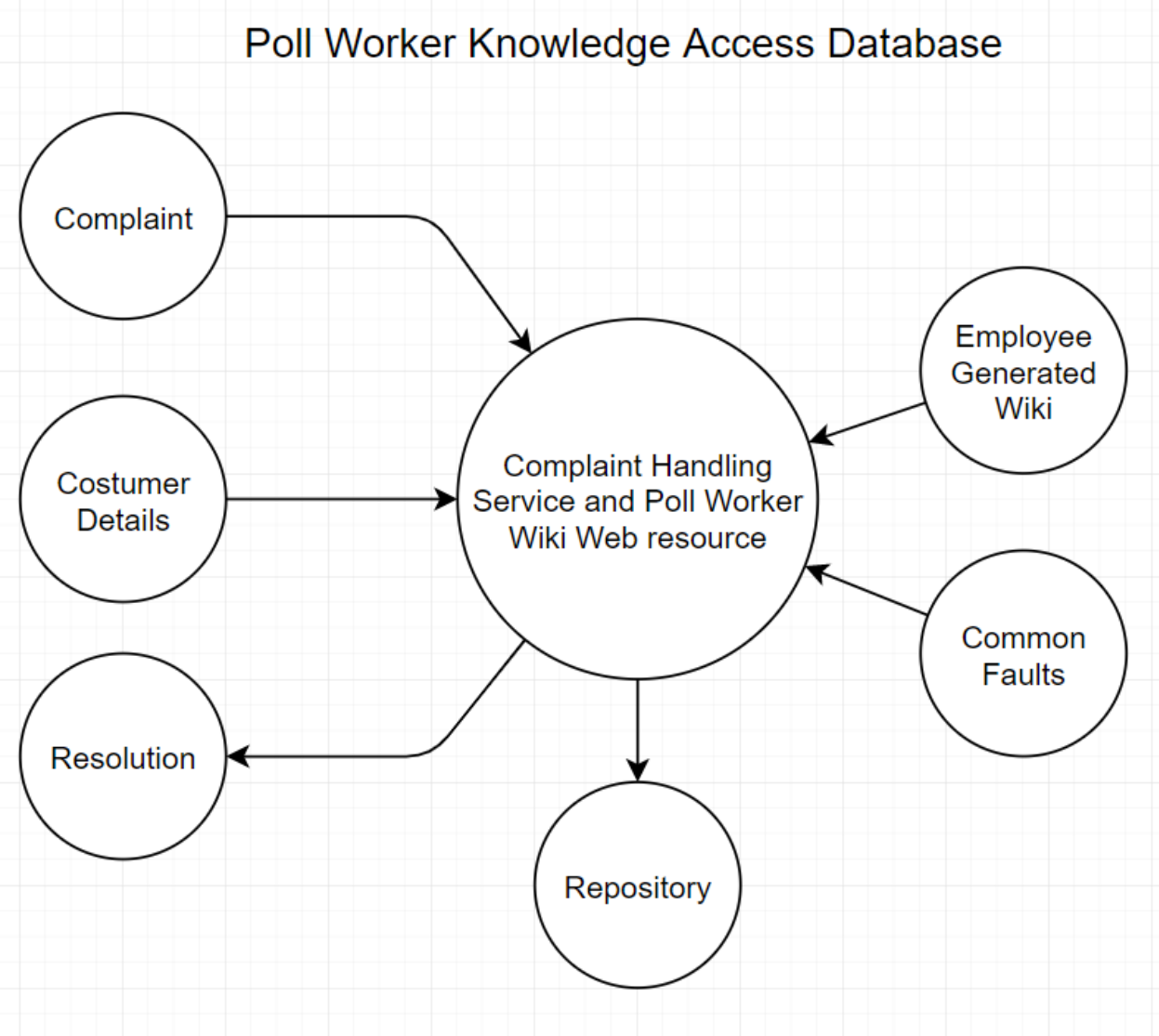
Milestone	Timeline	Requirement
Establish EAC	Complete	Complete
Decide on TOGAF® framework	1-2 months	Preliminary phases should be worked through during this process.
Grant authority to EAC to establish requirements for state-held elections	Before 2020 Election	EAC should: - Decide on timeline for voter registration and early voting. - Enforce specification for automatic registration at DMV. - Create Enterprise Architect roles and assign project managers to each state to improve voting system. - Establish auditing practices. - Decide on voting machine requirements for printer verification and auditing. - Decide on additional requirements for volunteering polling places to include power and network (where applicable)
Voter Coordination	2022 Election	EAC should: - Decide on one voting schedule that all states must follow. - Post dates to all government websites used for voting information. - Dedicate federal funding for advertisement and phone calls for promoting registration dates and early voting timeline. - Require all states to allow for All Mail-In ballots for all elections.
Automate Inventory Tracking	2022 Election Cycle	EAC should: - Select a system for the automatic tracking of assets and establish a system for updating machines on a timeline.
Voter Registration Data	2022 Election Cycle	EAC should: - Require all states to have online voter registration. - Require DMV, libraries, and post offices to allow for voter registration. - Decide on the mandatory requirement to use one chosen tool for cross checking voter registration data. States may use additional tools if preferred.
Single WOA for registration	2022 Election Cycle	EAC should establish data requirement for a single WOA registration portal as well as a research and development or contracted agency to implement.
Single WOA for online vote casting	2022 Election Cycle	EAC should establish a research and development team or contracted agencies to work on a secure online voting system.
Change voting day	2024 Election Cycle	EAC should move voting to a weekend to accommodate voters.
Single WOA for registration	2024 Election Cycle	Sample a portion of total voting states to utilize new voter registration portals. Add additional states in the coming election years.
Single WOA for online vote casting	2024 Election Cycle	Sample a portion of total voting states to utilize new vote casting portals. Add additional states in the coming election years.
Single WOA for registration	2028 Election Cycle	All states should now be using the new voting registration portals.
Single WOA for online vote casting	2028 Election Cycle	All states should now be using the new vote casting portals.

Conclusion

The above timeline should be worked towards even if not all milestones are possible. It is necessary to start with some improvements and changes as the current system is insecure and vulnerable to voter suppression. Urgency should be emphasized, but it must be drawn out with small victories to match with election cycles. “By far the biggest mistake people make when trying to change organizations is to plunge ahead without establishing a high enough sense of urgency in fellow managers and employees” (Kotter 1996). Along with urgency, changes in the American culture as well as the EAC should allow for these changes to occur. There is already a growing concern for election security and voter confidence. Moving towards a more secure and consistent voting system will increase voter confidence.

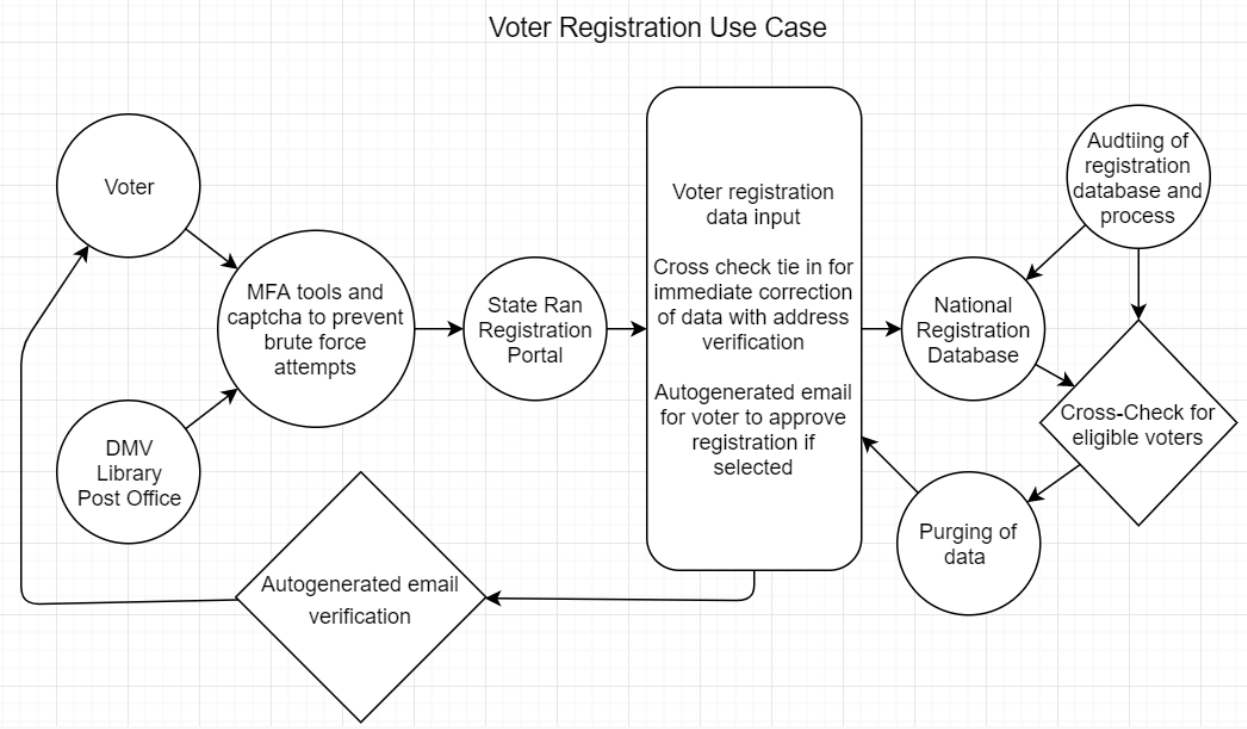
There are limited ways to test between election cycles. In order to ensure functionality, a paced rollout is preferred. States may be authorized to run elections, but there has already been a precedent for the federal government to establish laws that make certain practices mandatory. Giving more authority to the EAC with better resources would allow elections to run smoother and have established auditing practices. An online registration system with consistent datasets and an online voting system using WOA should be developed as this would be the best solution to help alleviate issues with voter suppression and other concerns regarding voting and intimidating polling places. Multiple voting methods should be retained as backup solutions and opportunities where certain technologies will not work.

Appendix A



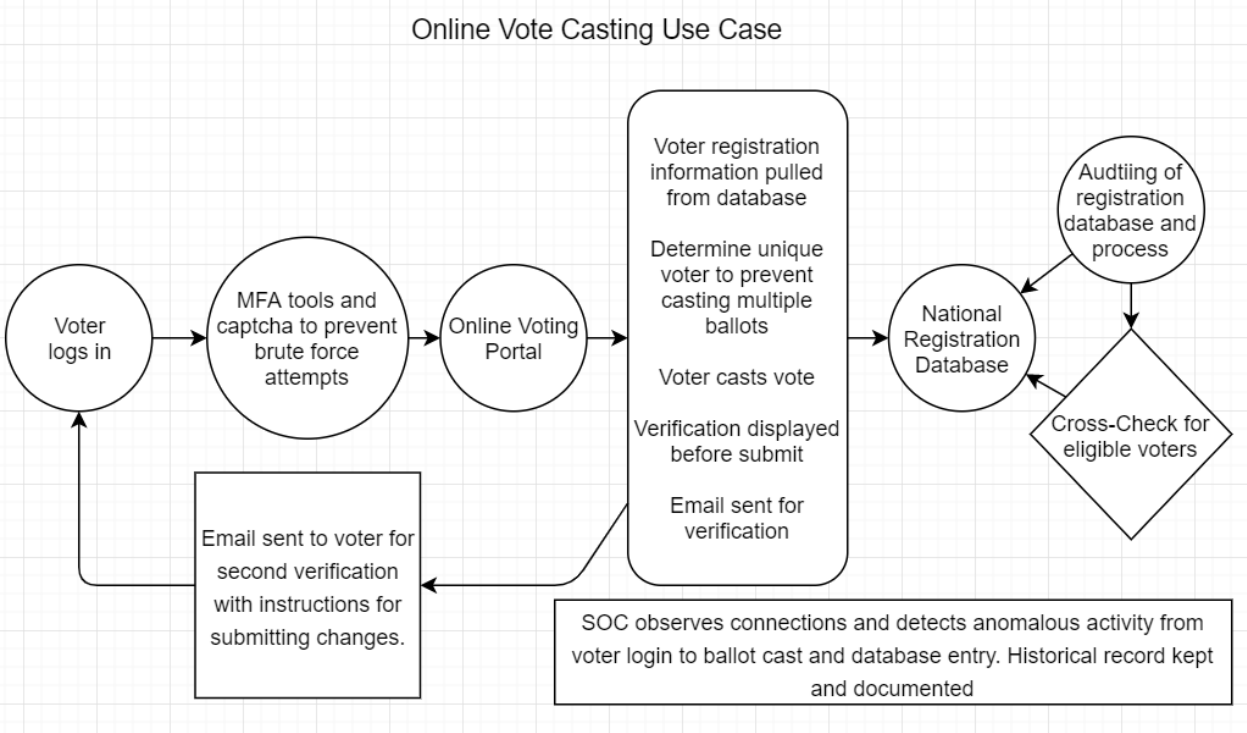
Appendix A – Poll worker knowledge base, ticket system for issues, and wiki

Appendix B



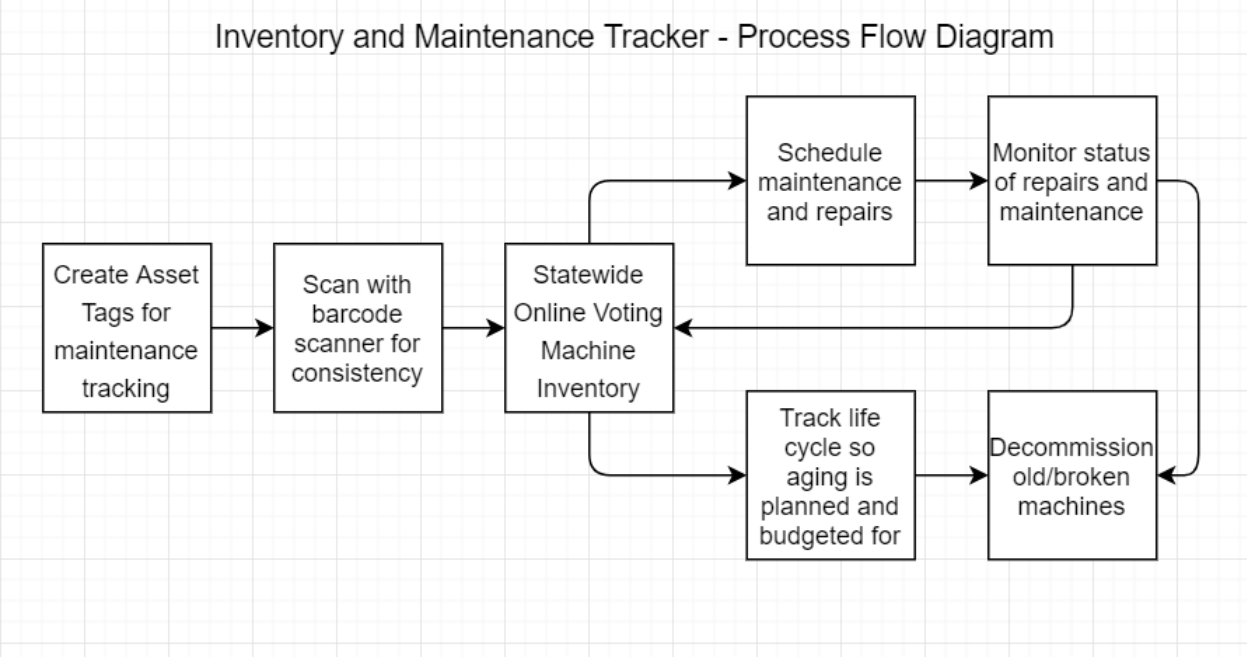
Appendix B – Voter Registration Use Case

Appendix C



Appendix C – Vote Casting Use Case

Appendix D



Appendix D – Inventory and Maintenance Tracker – Process Flow Diagram

References

Albert, Mark. 2018. “Kids as Young as 7 Hack into Election Systems at DEFCON Event.” *KCRA*. Hearst Television Investigative. Accessed November 9, 2019. https://www.kcra.com/article/kids-as-young-as-7-hack-into-election-systems-at-defcon-event/22748250#.

EAC. 2017. “FACT SHEET: Voter Registration List Maintenance.” *EAC.GOV*. EAC. Accessed November 7, 2019. https://www.eac.gov/assets/1/6/FACT_SHEET_-_Voter_Confidence_and_NVRA.pdf.

Editorial Board. 2018. “Our Voting Machines Are Aging Fast. Congress Should Improve Them.” *The Washington Post*. WP Company. Accessed November 9, 2019. https://www.washingtonpost.com/opinions/our-voting-machines-are-aging-fast-congress-should-improve-them/2018/11/11/8b09312e-e43d-11e8-ab2c-b31dcd53ca6b_story.html.

FairVote. 2019. “Voter Turnout.” *FairVote*. Accessed November 5, 2019. https://www.fairvote.org/voter_turnout#voter_turnout_101.

Hubler, Katy Owens, and Wendy Underhill. 2018. “Voting System Standards, Testing and Certification.” *NCSL- National Conference of State Legislatures*. Accessed November 6, 2019. http://www.ncsl.org/research/elections-and-campaigns/voting-system-standards-testing-and-certification.aspx.

Kotter, John P. 1996. *Leading Change.* Boston: Harvard Business School Press.

Mann, Christopher B., Beverly Buck, Josh Diller, Elisa Cohen, Amy Eller, Brian Gerber, and Jody Fitzpatrick. 2014. “Measuring Motor Voter.” *PewTrusts*. Accessed November 7, 2019. http://www.pewtrusts.org/~/media/Assets/2014/05/06/MeasuringMotorVoter.pdf.

Root, Danielle, and Adam Barclay. 2018. “Voter Suppression During the 2018 Midterm Elections.” *Center for American Progress*. Accessed November 7, 2019.

https://www.americanprogress.org/issues/democracy/reports/2018/11/20/461296/voter-suppression-2018-midterm-elections/.

Tokaji, Daniel P. 2018. “The Right to Vote in an Age of Discontent.” *American Bar Association*. Accessed November 5, 2019. https://www.americanbar.org/groups/crsj/publications/human_rights_magazine_home/we-the-people/right-to-vote-in-age-of-discontent/.

Underhill, Wendy. 2019. “State Laws Governing Early Voting.” *NCSL- National Conference of State Legislatures*. Accessed November 6, 2019. http://www.ncsl.org/research/elections-and-campaigns/early-voting-in-state-elections.aspx#Early Voting Law Table.

USA.GOV. 2019. “Voting and Election Laws.” *USAGov*. Accessed November 5, 2019. https://www.usa.gov/voting-laws.