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1 Introduction

The City and County of San Francisco (City) is considering the feasibility of its options for developing a highly accessible, open source voting system (System), and the costs and time frames associated with those options.

This report evaluates the feasibility of developing an open source voting system and highlights the risks, development options and the capabilities the City has to undertake its development.

Given these considerations, the City will have to evaluate how the opportunity to build this system balances out against the risk and investment it will take to do so. Furthermore, the City will need to evaluate its own willingness and ability to take on the challenges in building such a System.

1.1 Purpose and Organization of this Document

The purpose of this document is to inform the City of the feasibility of its options to create a highly accessible, open source voting system and the costs and time frames associated with the options

This document intends to:

- Lay out the scope of voting system to help frame the assessment and create cost estimates
- Explain the assumptions and considerations relative to Open Source software development, program delivery, system build, certification, run, and maintain phases
- Explain the required capability model required to successfully execute this project
- Confirm the options that were assessed, the methodology of assessment, and the evidence-based approach to evaluating those options
- Summarize the costs, timelines, and risks associated with each option
- Provide a set of actionable next steps for the project sponsor

This report does **not** intend to:

- Be a detailed design document for a voting system
- Make recommendations on specific partners, vendors, or technologies
- Provide a definitive option recommendation to the City and County of San Francisco
- Discuss the possibility of legislative change at the state or federal level

1.2 How to navigate this document

This report has four main ‘chapters’:

- **Section 1** summarizes the objectives, scope and methodology of the feasibility assessment
- **Sections 2 – 6** put the findings of the report front and center and include the summary analysis from the point of view of risk, cost, and time. These are the sections to focus on to understand the data and considerations when making a decision on this project.
- **Sections 7 – 9** are as educational/context setting and explain the considerations from a delivery, system build, and system maintenance perspective.
- **Sections 10 – 13** are the appendices that comprise more detailed information relating to system scope and capability model evaluation

1.3 Objectives of Assessment

This assessment has been created with the principles highlighted in the RFP. The critical goals that the project team had in mind throughout this assessment were as follows:

- Build trust in the accuracy of the election by creating a transparent and auditable end-to-end voting process

- Provide a voting experience that has a high level of accessibility and usability above minimum requirements for voting systems

Additionally, the project team was aware of the following sub-goal: to provide a base level of education to the reader on the complexities and implications of undertaking this project, and provide any suggestions that will make the undertaking of this project smoother.

1.4 Scope and Methodology of Assessment

The complexity of assessing the feasibility of an open source voting system first required an understanding of the high-level capabilities of a voting system to help create a baseline. It is from this high-level understanding that options of an open source voting system were extrapolated and evaluated across the dimensions of: Capability, Cost, Time, Risk.

A total of six (6) options were evaluated across the dimensions of: Capability, Cost, Time, Risk based on the research conducted to understand the high-level capability of a voting system.

This consisted of two phases. First, a review of laws, examination of existing systems and current trends in voting systems was conducted to help the project team define the scope of a 'voting system'. Next, this research was triangulated with the federal Elections Assistance Commission and the California Secretary of State to confirm the scope. This enabled the project team to define what a system would comprise so that time, cost, risk, and required capabilities could be estimated.

Over forty (40) interviews were held with stakeholders within the City's Election Department, technology departments, and special interest groups to understand the various group's ability to deliver a project of this nature and scale.

1.5 Critical Assumptions

In summary, the project assumes the following:

Strategy & Design

- No need to debate the explicit benefits of Open Source vs. Closed Source in this assessment; do need to clarify and explain all the risk and considerations of undertaking an open source strategy
- New voting system must comply with all voting system regulations and accessibility requirements
- When assessing delivery capability of each option, this is defined as a combination of track record, skillset, capacity/resource, and desire to own
- City of SF will continue to be a paper-based jurisdiction (the paper ballots will remain)
- The same number of polling places will continue to be utilized
- There will be ~double the number of Accessible Voting Device systems for use in precincts
- A critical set of 'start criteria' must be met in order to the project to initiate – see section 2.2 for the proposed list of these
- A coordinated discovery design phase will be completed that will confirm the overall architecture of the solution so that subsequent phase addressing the sub-systems will be in harmony.
- Accessibility analysis must be part of the overall program throughout the timeline i.e. during the design, the development, the testing, the rollout, and ongoing enhancements
- There is a requirement for all things to be accessible i.e. not just the system, but also the documentation/test scripts, reports, design docs etc. For example if system documentation is provided to the Open Source community it will need to be accessible via a screen reader for accessibility.

Development

- City of SF to 'own' everything and use Open Source community to increase quality/transparency.
- It is not the intent of the Open Source community to reduce cost or increase velocity of project (at least initially).
- It is not expected that coding will be done by the community during the build phase
- The Audit requirements will be clearly understood and reflected in the system design during the project discovery phase.
- Of the models of Open Source software development, it is assumed to be 'Benevolent Dictator for Life'
- Build by component and in a way, that delivers value soonest
- A 6-month timeline has been assumed for the tender process to execute on any RFPs – this needs to be tested upfront. It is assumed that one RFP would take 6 months per unit, not multiple RFPs per unit. In the case that multiple RFPs are required additional lead time will be required.

Maintenance and Certification

- Decision point at eighteen (18) weeks prior to the next election to make determination if a feature is considered major (or minor, or administrative), since procurement of new consultants to handle testing for those features takes 10 weeks
- Certifying a system (like the one proposed) in pieces has never been done before so some assumptions were made after a conversation with the Secretary of State. End to End Certification Timing Assumption:

Components being Certified	Timing
Full Build of Component	6-12 months
Major Feature	2 months
Minor Feature	1 month
Bug Fix	1-2 days

2 Feasibility Summary

Six different delivery options (described in section 4) were evaluated during this assessment. We believe that the highest likelihood of project success combines parts of multiple options in addition to the mitigation of key project risks.

Given the inherent challenges of this endeavor and based on our research the most feasible approach is to:

- Have this program be owned by the city, specifically the Department of Technology. Hire or reassign the required expertise to administer and guide this project.
- Enlist multiple vendors for the entire build phase and contract them for ongoing operational support.
- Commit to building the Open Source community and only start relying on the community for delivery of new features once it has been proven to be engaged and reliable.
- Partner with LA County that has developed human-centered/accessibly designed furniture and electronic voting devices already[1].

[1] http://vsap.lavote.net/process/

- Partner with a jurisdiction, ideally within California, so that the certification is only with one body - the Secretary of State of California. This will allow for sharing of costs.
- Partner with existing open source voting group(s) like (but not limited to) OSET Institute to learn from and possibly build upon the assets that they have already created.
- Approach the project in an agile manner aiming to provide value as soon as its developed.
- Conduct an in-depth assessment of Open Source licensing models and only proceed with an Open Source license when the implications are understood by key city stakeholders such as IT and the legal department.

2.1 Key Risks and Mitigation Actions

For a project of this nature to be successful, the following risk factors must be considered with regards to developing, sustaining and securing the system.

2.1.1 Change to Current Solution Delivery Model

Building a system like this requires a shift from the City's preference of configuring to coding a new software system to which the City would have to commit to. Even with reliance on outside vendors, there will be a significant need for leadership, decision-making, and product management in house.

The City should:

- Determine if they are willing to make this shift and if so commit to develop this capability (the components of which can be found in the Capability Model in the appendix)
- Position this capability in the Department of Technology
- View this as a capability which will serve this effort first then be refocused on the next custom application

2.1.2 No Specific Requirements for a Voting System

This report does not present a design of the voting system. Although some thinking has been done to scope out what a prototypical voting system would entail, actual system requirements have not been gathered. Therefore, a minimum of **+100% margin** should be applied to both the timeline and costs (both upfront and ongoing).

The City should:

- Commit to a Discovery phase for this project. This engagement would develop a clear picture of what success looks like and how specifically the voter's needs will be met. It also involves a deep dive into the critical success factors such as technical constraints, licensing, program operating model, procurement and possible coordination with other organizations or jurisdictions.
- Use the output of this engagement to issue an RFP with an amount of detail which will increase the likelihood of multiple vendor's responding.

2.1.3 Ability to attract and engage multiple vendors

Travis County TX attempted to find vendors to build an open source voting system called STAR-Vote. In the end they did not find a vendor that was interested in the Open Source model and had to change their approach[2].

[2] http://www.mystatesman.com/news/travis-county-ditches-plan-craft-its-own-voting-system/15GsWZ8FnWntGgUz25L1TL/

The City should:

- Have a backup solution in case this approach does not deliver a reliable voting system.
- Expect that they will likely have to work with many different vendors to deliver and maintain the entire solution.
- Commit to a Discovery phase and use the outputs from this phase to provide a well-defined set of RFPs which will reduce the perceived risk for vendors.

2.1.4 Ability to establish a healthy, functional, and reliable O/S Community

The development of an Open Source community requires time and attention and the City needs to decide if this is a focus that they want to have. The City does not have a track record for building thriving Open Source communities nor is it its focus to do so. There is also not an analogous model to make assumption around since a project like this has never been completed in the United States, at least not at this scale. Without a commitment to building an Open Source community this project will not achieve its full potential. It is possible that this community could form organically but for value to be derived for this project the work of that community still needs to be incorporated into the code stream and put through the certification process which will not be able to be done by the community.

The City should:

- Decide if they want to commit to building this community.
- If they decide to they should they should hire at least two initial resources for this effort. One will be a technical architect who will focus on the technical aspect and impact of incorporating code and input from the community as well as tooling and documentation to empower those who are interested to participate. The second is an Open Source program manager who will initially focus on evangelism to grow the community, communication with the community and community structure and operations.

2.1.5 Certification of the system(s) with the Secretary of State

The State certification process as it operates today is the certification of an entire system end to end and has only been done with commercial vendors. In a more incremental/agile delivery methodology there is a need for a more flexible and adaptable certification process that can triage between administrative, minor, and major changes as the system is being developed

From initial conversation with the Secretary of State they are open to this nimbler approach. This however has not yet been proven and poses a serious risk to the project's ability to deliver in this way, as well as the assumptions and estimates of timing.

The City should:

- Conduct a Discovery phase where this interaction model with the state will be documented and negotiated with the Secretary of State.
- In addition, the Discovery phase should define a specific phased approach to implementation examining the existing system and the constraints it will impose. This will better define the requirements of how the City of SF and the State will need to work together.

2.1.6 Open source licensing

Open source licensing as they exist today may not be sufficient for the purposes of the System being built for elections. Although the Department of Elections expressed a preference for Version 3, GNU General Public License as they believe it provides other users the greatest access to view, modify, and use a System's software code, it is worth evaluating whether this will meet all needs and stages of the product

The City should:

- Align and agree on the license with which the city is most comfortable.
- Engage key project stakeholders and the legal department for the city to do a full analysis of licensing models and the implications of each.
- Consider if that value proposition can be addressed by a non-Open Source method.
- Strongly codify the value proposition and rational of conducting this project as an Open Source project.

The OSET Institute has created their own open source license to address some issues they perceive to be an issue with government engagement. Two specific points of rationale that they have outlined in their document[3] "RATIONALE DOCUMENT—VERSION 2.2" :

> *"**1. Governing Law**. Most government procurement regulations require the application of local state law or federal law to the material terms and conditional s of any contract. Most open source licenses lack law or venue selection provisions. Also, the application of particular law affects the interpretation of a license document as a whole, and therefore, we conclude, is necessarily a modification to all of its terms. Thus, to agree in a separate contract that a particular body of law applies to a license would be an additional restriction on that license.*
>
> ***2. Venue.** Many state and federal procurement regulations require that disputes be resolved in particular venues. Please see our comments above regarding governing law."*

2.1.7 Partnerships effect on delivery timeline

If collaborating with other jurisdictions, there is a risk that the City of SF and their schedule and priorities differ.

The City should:

- Evaluate these partnership options and determine what mitigations can be put in place to maintain control of the requirements and timeline.

2.1.8 Legislative constraints

The City of SF is a paper-based jurisdiction. This is assumed to be the case going forward. This project's expenditure is to replace the existing electronic voting machine with a more accessible solution developed in an open source manner. The plan is to replace the one-per-precinct model, with at least two in each to ameliorate the risk of longer wait times to use the electronic voting machine. This does not replace the paper-based system, and all the expenditure for that system will remain.

If this constraint can be lifted, the City can see a greater use of the electronic voting machine and a replacement of the paper-based system.

The City should:

- Conduct an analysis of the cost and value trade off to change the legislative constraints.

2.1.9 Security Risk

In addition to the scrutiny placed on the development of this system from a state certification perspective, there will be additional public attention and pressure on whomever develops a voting system, especially one developed in such a transparent fashion. If the City develops a new system

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3 https://static1.squarespace.com/static/528d46a2e4b059766439fa8b/t/55fcc566e4b049b6f6c15194/1442628966530/OSETPublicLicenseRationale_v2.2.pdf

from scratch they need to be comfortable with the transfer of responsibility for security from a shared responsibility (vendor and City) today to a complete responsibility. Alternatively, they need to find a build and run partner who is willing to assume this responsibility with them.

The City should:

- Consider if this risk is one it is willing to assume.
- If not, then look for partners who can share the responsibility and clearly define the liability assumed by each party or parties.

2.1.10 Quantifying value of the program

It is hard to determine the quantified value and benefit of this program in terms of the public good. This is an evaluation that can only be made by the city in light of its other needs.

The City should:

- Conduct an assessment and comparison of the alternatives uses for this capital should be conducted to ensure that this investment is appropriately prioritized against the City's portfolio of needs.

2.1.11 Complexity of souring vendor support and managing multiple concurrent RFPs

The City's procurement via RFP from vendors includes a number of process complexities and requirements that impact the timeline of any project. Running an RFP process can take a considerable amount of time, energy, and cost. It important to be realistic in the overall number of RFPs and the bandwidth of the group that is able to execute on managing them. This feasibility report expects that when soliciting support from vendors, it is expected that a single RFP would be released for the overall discovery and high-level architecture design phase; with subsequent RFPs per each of the seven sub-system elements presented in Section 3 and within the phases described in Section 8. This would put the number of RFPs in the range of 8-10 in total (i.e. one for discovery/design and then approx one per sub-system element).

Additionally, later in **Section 8.2 (Agile vs Waterfall)** the concept of Agile vs. Waterfall project delivery is considered. When it comes to the procurement of services, it is expected that the overall 'Epic-level' user stories will be defined in a waterfall approach up front and that the subsequent build phases, or sprints, would occur in a more agile manner.

The City should:

- Determine which office within the city has the capacity and capability to run the RFP process(es)
- Commit to finding a single vendor for the design phase in order to reduce the overall program risk
- Limit the number of RFPs to a the smallest possible number to decrease complexity. A strategy for doing this should be developed in the discovery phase.
- Evaluate the optionality for vendors to bid on more than one sub-system so as to generate economies of scale in their detailed design and development

2.2 Critical Project Initiation Criteria

There are a number of milestones that must be reached or actions that need to be undertaken before we can assume that the project has officially started and the overall project timeline can commence.

These are as follows:

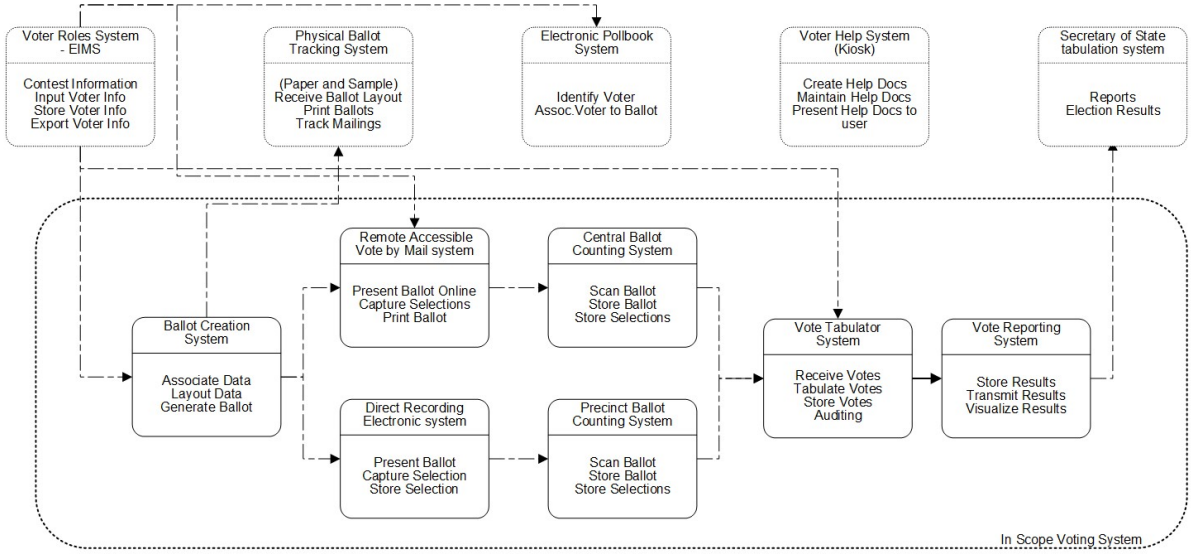
1. Obtain a Memorandum of Understanding from the Secretary of State
    - To confirm that the modular nature and agile production process of the system design and build can be certified in a timely manner and that a service level agreement can be established, or at the very least written assurances of the ability to meet certain timelines for certification given agreed upon criteria.
2. Open Source License Legal Review
    - Complete the legal review of the open source license type (GNU Public License, version 3) that the City has identified as their preference to confirm any issues throughout the product lifecycle
3. Prepare For and Officially Initiate a Project
    - Select a proposed option: Based on the evaluated options, determine which options makes most sense to move forward with project.
    - Determine Project Leadership: Define requirements for leaders (e.g. project owner, product owner, budget manager, program manager).
    - Build Project Operating Model: Understand and build out a model for what the organizational structure will look like to run the project, and how they will deliver value.
    - Define Roles & Responsibilities: Define requirements for what each team member must do to be successful.
4. Finalize Budget and Funding
    - Define Budget: Define total amount of financial resources that needs to be allocated for this project, including YoY costs, capital/operating expenses, etc.
    - Determine Funding Allocation: Allocate funding per department resources needed, and see if there are gaps that need addressing.
    - Plan and Estimate Spending: Within each category of spend, determine the forecast of costs over time and the means by which each will be tracked. Allow for cost contingency on any external contracts, and time contingency on internal spend.

3 System Build Scope

Defining the requirements for an Open Source voting system is not in scope for this feasibility study. This poses a challenge when trying to determine the scope, capabilities needed, cost and timeline to deliver one.

To address this issue, a generalized model of a voting system was created. First, a review of laws, examination of existing systems and current trends in voting systems was conducted to help the project team define the scope of a 'voting system'.

The diagram below shows the components of the model 'voting system' which was used for cost and timeline estimates. For more details on the methodology used, please refer to Appendix B - Proposed Voting System.



4 Description of Delivery Options

A total six different delivery options were identified, and these have been detailed in the table below.

#	Short Name	Description
1	Dept. of Elections Only	*Ownership:* The Department of Elections (Department) will be held accountable for the project's success, and election to run smoothly on Election Days. *Development:* The IT staff within the Department will i) build the source code, ii) purchase hardware, iii) run/maintain the entirety of the project to make sure it will be certified *Open Source Community Engagement:* Department will govern and own the interaction with the community *Support:* All capabilities will lie in the Department of Elections, with no support from other departments in the City or external vendors involved. *External Vendors:* None

#	Short Name	Description
2	The City of SF Only	*Ownership:* The City of SF will assign ownership to specified departments, with one department providing high-level oversight and guidance to ensure project delivery. *Development:* The Technology Departments in the City (e.g. Digital Services) will provide all capabilities to develop the voting system and run/maintain the project through its completion. *Open Source Community Engagement:* The City governs and own the interaction with the community *Support:* All capabilities will lie in the Technology Departments in the City with no external vendors involved. *External Vendors:* None
3	Vendor support without existing assets	*Ownership:* Ownership of the project remains with the City *Development:* A new voting system will be developed with vendors from scratch rather than building those capabilities in-house *Support:* The City or Department will bring in needed capabilities from external vendors via RFP or other contractual vehicles *External Vendors:* Yes
4	Vendor support with existing assets	*Ownership:* Ownership of the project remains with the City *Development:* A new voting system will be developed with vendors by building upon external party's existing assets rather than building from scratch *Support:* The City or Department will bring in capabilities from external parties via RFP or other contractual vehicles *External Vendors:* Yes
5	Collaboration with Jurisdictions within CA	*Ownership:* Jurisdictions within California will share ownership and create a voting system with the rationale being that a system that services Californian jurisdictions will only have to be certified by the California Secretary of State. *Development:* Collaboration with jurisdictions within California to create a voting system that meets requirements for the participating jurisdictions. *Open Source Community Engagement:* Collaboration with jurisdictions within California to manage interactions with the community *Support:* The Technology Departments in the Department of Elections or the City will collaborate with other jurisdictions within California to share resources in order to provide all capabilities to develop the voting system *External Vendors:* None

#	Short Name	Description
6	Collaboration with Jurisdictions outside of CA	*Ownership:* Ownership of the project remains with the City *Development:* Collaboration with jurisdictions outside of California to create the System *Open Source Community Engagement:* Collaboration with jurisdictions outside of California to manage interactions with the community *Support:* The Technology Departments in the Department of Elections or the City will collaborate with other jurisdictions outside of California to share resources in order to provide all capabilities to develop the voting system *External Vendors:* None

(1) The City joining Travis County's project was a listed option in the RFP, but cannot be evaluated as an option anymore as the project has been cancelled.
(2) Each option can be permutated in ways that can involve external vendors via RFP.

5 Costs and Timeline

There are three major areas of cost considerations for this project. These break down into

i) Development Costs which vary upon how the System software is developed,

ii) One-Off Fixed Costs for System hardware and certification, and

iii) Ongoing costs that would be required to maintain the system and carry out elections

To develop the cost model, we used the information from the **System Build Scope** section and assumed the most likely delivery method, which is for the city to own the overall program but use vendors for the development of the system and on-going maintenance. The costs shown in this section reflect that model of delivery. Starting in **Professional Services Build Cost – Per Option** we consider the cost impact of using six different delivery options.

As stated before defining the requirements for the City's Open Source voting system is not in scope for this feasibility study thus a 100% margin should be applied to these costs.

The build timeline estimated for the baseline option is **3-6 years** – further details can be found in **System Build Considerations (Section 8)**

A summary of costs is provided here with a further breakdown in the following sections.

Category	Description	Costs*	Frequency / Time period
Professional Services associated with Development of System (Build Phase)	• Discovery • Ballot Creation System • Remote Accessible Vote By Mail System • Accessible Voting Device System • Precinct Ballot Counting System • Central Ballot Counting System • Vote Tabulator System • Vote Reporting System	**$ 11.5M – $ 27.8M**	Over the course of the build and implementation (~3-6yrs)*
Hardware	• Ballot marking device • Furniture • Peripherals • Scanners	**$ 6.35M – $ 16.4M**	One-off

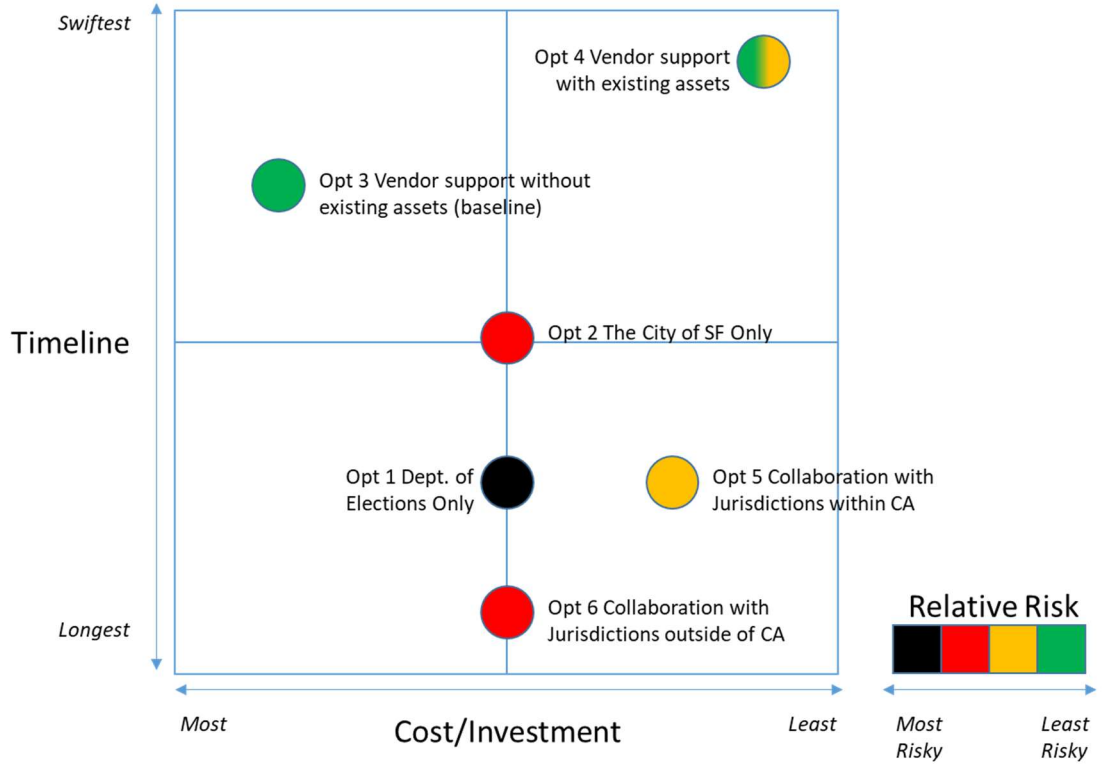
	• Precinct scanners		
Certification	• Deposit	**$ 0.4M**	One-off
On-going	• Hardware Storage (Accessible Voting Device) • Application Hosting • Professional Services Roles	**$ 3.3M-6.6M**	Per year
Per Election	• Support • Paper Ballot Costs • Poll workers for day of election • Poll worker training • Maintenance and Licensing	**$ 3.4M-4.83M**	Per election

**based on a +100% contingency*

5.1 Assessment of Delivery Options

Each of the City's options to deliver a highly accessible open source voting system were evaluated across the dimensions of capability, cost, time and risk. The graph below displays these options evaluated across cost of development and time to completion.

Note that the axis of the graph below is inversed, hence the lowest cost and time to completion option is to the top right of the graph. Additionally, the level of risk corresponds with the color of the circle.



5.2 Build Phase Costs

5.2.1 Professional Services Build Cost - Baseline

There are seven components that were estimated to be in scope for this System and costs of each component was determined by creating a model with the following parameters:

- Skill set required
- Duration of the project
- Utilization each resource required

The numbers below reflect our baseline costs and assume that the City will own the overall program, but vendors will be contracted to do the build. These costs do not include hardware costs those are provided in section 5.1.3.

System Component	Cost	Notes and Assumptions
Discovery	$1.1M-1.2M	Cost basis: 4 month duration with 7 resources (full and partially engaged) at an average rate of ~ $263/hr Develop a clear picture of what success looks like and how specifically the voter's needs will be met. It also involves a deep dive into the critical success factors such as technical constraints, licensing, program operating model, procurement and possible coordination with other organizations or jurisdictions. Since the project is expected to be delivered in an agile way the discovery does not define all requirements. It seeds the development process with the highest value work first and provides a holistic view of the project challenges and proposed approaches. Each of the sub-systems will also include a discovery phase to begin.
Ballot Creation System	$1.2M – $3.0M	Cost basis: Average rate of $237/hr Build -- 5 month duration with 8 resources (full and partially engaged) Certification – 5 month duration with 4 resources (partially engaged only)
Remote Accessible Vote By Mail System	$0.99M – $2.4M	Cost basis: Average rate of $238/hr Build -- 4 month duration with 7 resources (full and partially engaged) Certification – 4 month duration with 4 resources (partially engaged only) Requires Ballot Creation work to be completed first
Accessible Voting Device System	$4.5M – $11.0M	Cost basis: Average rate of $245/hr Build -- 8 month duration with 14 resources (full and partially engaged) Certification – 8 month duration with 7 resources (partially engaged only Largest most complex component
Precinct Ballot Counting System	$1.1M – $2.8M	Cost basis: Average rate of $238/hr Build -- 5 month duration with 7 resources (full and partially engaged) Certification – 4 month duration with 4 resources (partially engaged only

System Component	Cost	Notes and Assumptions
		Slightly less on certification costs past this point since the certification process should be well understood by this point in development.
Central Ballot Counting System	$0.95M – $2.4M	Cost basis: Average rate of $238/hr Build -- 4 month duration with 7 resources (full and partially engaged) Certification – 4 month duration with 4 resources (partially engaged only Assumes Precinct Ballot Counting System is done first.
Vote Tabulator System	$0.85M – $2M	Cost basis: Average rate of $243/hr Build -- 3 month duration with 8 resources (full and partially engaged) Certification – 3 month duration with 4 resources (partially engaged only
Vote Reporting System	$0.86M – $2M	Cost basis: Average rate of $237/hr Build -- 3 month duration with 8 resources (full and partially engaged) Certification – 3 month duration with 4 resources (partially engaged only
Build Total	**$11.55M – $27.8M**	

5.2.2 Professional Services Build Cost – Per Option

The City has options for developing a highly accessible Open Source voting system. The System can be developed by the Department of Elections, the City of San Francisco, with support from external vendors and in collaboration with jurisdictions within and outside the state of California. The description, capabilities, risks and gaps with regards to each option differ and this has been detailed in **Section 6** of this document. In this section, we explore the cost and time variance from the baseline estimated above.

5.2.2.1 Option 1: Department of Elections Only

This option explores if the System is developed by the Department of Elections with no support from external vendors.

The baseline cost as broken down in **Professional Services Build Cost - Baseline** is estimated to be around $11.5M - $27.8M with an estimation of 3-6 years for its build. The deviation from this baseline is detailed below:

	Estimate	Variance	Justification
Cost	**~$8M – 19.5M**	Approximately -30% variance from baseline cost estimate	• FTE costs is less than the contractors rate hence the costs will be lower than baseline

Time	4 -8 years	Approximately +1year variance from baseline time estimate	• Each resource takes a lot longer to hire • With fewer resources, the timeline may increase • Description of skillset can be found in the Capability Model
Risk	BLACK	Significantly higher risk than baseline	• Disruption from purpose of department • Weak Capability Model. Further details can be viewed in **Section 6**

5.2.2.2 Option 2: City of San Francisco Only

This option explores if the System is developed by the City of San Francisco with no support from external vendors.

The baseline cost as broken down in **Professional Services Build Cost - Baseline** is estimated to be around $11.5M - $27.8M with an estimation of 3-6 years for its build. The deviation from this baseline is detailed below:

	Estimate	Variance	Justification
Cost	**~$8M – 19.5M**	Approximately -30% variance from baseline cost estimate	• FTE costs is less than the contractors rate hence the costs will be lower than baseline
Time	3.5-7 years	Approximately +0.5 year variance from baseline time estimate	• Need to hire people but the City has more capabilities currently in place to execute the Build
Risk	RED	Higher risk than baseline	• Lower visibility into Department of Elections needs. • Some specialization can be provided by existing resources but complete capability is not currently set. • Capability Model can be viewed in **Section 6**

5.2.2.3 Option 3: City of San Francisco with vendor support without existing assets

This option is the baseline estimate for the cost, risk and time to build the System defined in **Professional Services Build Cost - Baseline** above.

	Estimate	Variance	Justification
Cost	**~$11.5M - $27.8M**	N/A – Baseline	• N/A - Baseline

Time	3 -6 years	N/A - Baseline	• N/A - Baseline
Risk	GREEN	N/A - Baseline	• Least risky option

5.2.2.4 Option 4: City of San Francisco with vendor support with existing assets

The baseline option for delivery is that the City of San Francisco pools its resources and brings in help for the build from outside vendors. This option differs from the baseline as the System is created with the support of vendors that building upon existing assets.

The baseline cost as broken down in **Professional Services Build Cost - Baseline** is estimated to be around $11.5M - $27.8M with an estimation of 3-6 years for its build. The deviation from this baseline is detailed below:

	Estimate	Variance	Justification
Cost	**~$7M – 16.7M**	Approximately -40% variance from baseline cost estimate	• Building upon existing assets results in a lower cost due to shorter time to completion.
Time	2.5-5 years	Approximately -0.5 year variance from baseline time estimate	• Building upon existing assets results in a shorter time to completion.
Risk	GREEN/AMBER	Slightly higher than baseline	• Existing assets may not have been built with SF needs as a priority. This poses some risk as existing assets may need to be re-engineered to fit the needs of the City

5.2.2.5 Option 5: City of San Francisco in collaboration with jurisdictions inside California and without vendor support

The baseline option for delivery is that the City of San Francisco pools its resources and brings in help for the build from outside vendors. This option differs from the baseline as the System is created in collaboration with jurisdictions within the state of California. The rationale being that a system that services Californian jurisdictions will only have to be certified by the California Secretary of State.

The baseline cost as broken down in **Professional Services Build Cost - Baseline** is estimated to be around $11.5M - $27.8M with an estimation of 3-6 years for its build. The deviation from this baseline is detailed below:

	Estimate	Variance	Justification

Cost	**~$7.5M – 18.0M**	Approximately -35% variance from baseline cost estimate	• FTE Cost is less than contractor rate (~50%) • Able to share development and certification costs with other jurisdictions
Time	4-8 years	Approximately +1 year variance from baseline time estimate	• Collaboration results in increased complexity of execution
Risk	AMBER	Moderately higher than baseline	• Lack of control over focus / priorities • Complex solution without a full set of capability coverage. More details on capability assessment can be viewed in **Section 6** • More parties to manage

5.2.2.6 *Option 6: City of San Francisco in collaboration with jurisdictions outside California and without vendor support*

The baseline option for delivery is that the City of San Francisco pools its resources and brings in help for the build from outside vendors. This option differs from the baseline as the System is created in collaboration with jurisdictions outside the state of California.

The baseline cost as broken down in **Professional Services Build Cost - Baseline** is estimated to be around $11.5M - $27.8M with an estimation of 3-6 years for its build. The deviation from this baseline is detailed below:

	Estimate	Variance	Justification
Cost	**~$8M – 19.5M**	Approximately -30% variance from baseline cost estimate	• FTE Cost is less than contractor rate (~50%) • Splitting costs will be lower, but will have to account for the expense to accommodate requirements and regulations across participating states
Time	4.5-9 years	Approximately +1.5 year variance from baseline time estimate	• Collaboration results in increased complexity of execution • Differing certification processes across states since some states can bypass direct federal approval
Risk	RED	Higher risk than baseline	• More states mean even more complexity of regulations and laws • Collaboration across states may be challenging • Certification process may be more complex than just CA

5.2.3 Hardware Costs

There are two major hardware costs to be considered. The first is the per unit cost of the Accessible Voting Device and the second is the scanners required for the solution.

Type	Cost	Notes
Accessible Voting Device units	$3.05M - $ 9.8M	Assuming 1220 units at $2500 per. Includes peripherals for accessibility, scanning/printing and furniture. LA county's project which is ready for manufacturing has a per unit cost of 4k per unit. This forms the higher end of the estimate.
In-Precinct Scanners	$3-6M	Assuming 610 scanners at $4800 per. This is the same as is in use today.
Scanners	$0.3-0.6M	Industrial High Speed Scanners - deliver and setup
Per Election Total	**$6.35M - $16.4M**	

5.2.4 Certification Costs

The State of California certification process represents a significant cost to the project. The professional services cost already includes the consulting costs required (approximately 15% of the professional services costs) to oversee the process.

In addition, there is a deposit cost paid to the State for certification. It is estimated this number will be **$360k** for the overall system/solution.

5.3 On-Going Costs

After the build phase has been completed it is expected that a dedicated team will remain focused on the project full time. It is possible that with increased community engagement this team could be reduced over time. As with the build we have assumed a professional services firm will play most roles.

We have assumed that a few of the roles already exist and would therefore be filled by existing the City of San Francisco employees and represent a sunk cost. Those roles are: Executive Oversight, System Administration and Quality Assurance.

Type	Cost	Notes
Hardware Storage (Accessible Voting Devices)	$1-2M	Assumes the continued usage of Pier 48 as is being used today.
Application Hosting	$0.5-1M	It is expected that where possible cloud-based hosting will be used.
Professional Services Roles	$1.8-3.6M	The roles expected from professional services would therefore be: Program Management (1), Product Ownership (1), Open Source Community Management (1), Software Architecture (1) and Software Engineering (1). Hourly costs for these roles are expected to be slightly less than the rates in the build phase due to the full year commitment.
Total	**$3.3-6.6M**	

5.4 Per Election Costs

There are a set of activities and costs required per election. An example of this would be support of the Accessible Voting Devices in case of failure. In addition, there are costs for resourcing, ballots and maintenance. Current costs from the Dominion contract were considered and adjusted based on the change in systems. It is assumed that the Accessible Voting Device count would go from 610 today to 1220 in the new system.

Per Election Costs	Cost	Notes
Support	$0.985-1.97M	Support of the technology and machines used during elections.
Paper Ballot Costs*	$1.4M	Paper ballot costs are not expected to change. Accessible Voting Devices will support the existing paper-based process instead of replacing it.
Poll workers for day of election*	$0.505M	$142 to $195 stipend for 3k workers.
Poll worker training*	$0.015M	10 people by 16 hours at 85/hr rounded up to 15k
Maintenance and Licensing	$0.468-0.936M	Current Dominion system cost for this line item is $483K. The licensing fee is eliminated by an open source system but offset by the maintenance costs of doubling Accessible Voting Devices from 610 today to 1220 in the new system.
Per Election Total	**$3.373-4.83M**	

* These costs are the same as those incurred presently and thus represent no change from the current state. They are included here to confirm that there is no additional costs in these categories.