Implementing and Overseeing
Electronic Voting and Counting Technologies

Case Study Report on Brazil Electronic Voting: 1996 to Present

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CASE STUDY REPORT ON BRAZIL ELECTRONIC VOTING, 1996 TO PRESENT

IFES and NDI conducted a case study of Brazil to examine the country's experience and lessons learned from the use of electronic counting technologies in its elections since 1996. Brazil began the process of transitioning to electronic voting after the 1994 general election, and the Brazilian experience since then has been characterized by a rapid transition to universal electronic voting by the 2000 election for approximately 100 million voters. One of the chief characteristics of the Brazilian move toward electronic voting has been the large role played by the *Tribunal Superior Eleitoral* (TSE) – the institution responsible for managing elections, advocating for and implementing electronic voting – and the relatively little role played by civil society and oversight groups, until recently. One of the implications of this development for electronic voting in Brazil is the balance between implementation and oversight, and how this balance has been challenged in recent years through greater calls for transparency and oversight by civil society actors.

DECISION MAKING PROCESS ON ELECTRONIC VOTING

Brazil began shifting toward electronic voting in 1994. The impetus for the initial move to e-voting was largely led and managed by the TSE. The TSE has jurisdiction over all aspects of elections in Brazil and regulates the functioning of political parties. Over its history, the TSE has developed a reputation for trustworthiness, competence and autonomy in the management of the electoral process. In addition to its election management role, the TSE is also responsible for revising the electoral law every two years and submitting it to the legislature for approval, as required by Brazilian law. Because of its good reputation, the electoral law submitted by the TSE is rarely debated; and this gave the TSE significant leeway to purse electronic voting as a solution to challenges faced by the electoral process. While outside actors had some input, the move to electronic voting was largely an autonomous process carried out by the TSE, and consequently, actors within the judicial institution made most of the major decisions.

There were two primary reasons why the TSE adopted electronic voting machines (EVM). The first was to combat endemic fraud in the paper ballot tabulation process. The second was to address issues related to electoral accessibility and spoiled ballots in the paper voting system. Due to Brazil's complex electoral rules, voters regularly have to choose from thousands of legislative candidates. This makes results tabulation a logistical challenge because the paper voting system involves hundreds of thousands of vote counters who were often government employees from State-owned banks or the postal service. Because of the scale of the task, vote counting could take weeks and this post-election period was a time of great uncertainty and tension.

Most importantly, the lengthy tabulation period increased opportunity for vote counters allied with candidates to manipulate the vote count because the lengthy vote count was difficult for partisan and other civil society actors to fully monitor. The most common type of fraud was manipulation of the tabulation sheets

known as "maps" where vote counters who were allied with candidates would subtract votes from one candidate's tally and add them to the favored candidate's count.[45] This type of electoral fraud became a national issue after the 1994 presidential and legislative elections when a scheme to manipulate the election results involving electoral judges was uncovered in Rio de Janeiro. The local branch of the TSE was forced to annul the results for the legislative elections and hold a new one, leading to questions about the pervasiveness of fraud in elections.

A secondary motivation for switching to electronic voting was due to accessibility problems in the paper-based system. This system was a hugely complicated, as it required voters to write in the name or identifying number of their preferred legislative candidate. Two factors, the large number of candidates in legislative races, as well as the level of illiteracy in the country (approximately 20 percent, according to the 1990 census) resulted in almost 40 percent of votes being blank or invalid in 1994 legislative elections. These factors were compounded by the fact that, in legislative elections, voters voted for multiple offices and would fill in several names or numbers to cast votes for all offices. TSE officials argued that the high number of blank votes cast could be attributed to illiterate voters, who did not want to take a long time writing in a name, revealing they could not write.

The disenfranchising effect of complex ballots also made fraud easier, as described by Federal Deputy Tourinho Dantas:

> If an illiterate voter doesn't know how to read or write, how can he vote? They humiliate themselves at the moment in which they vote. When he goes to the ballot booth and he doesn't know what to do, he casts a blank vote. This vote, in the majority of places, is filled out by those perpetrating fraud. It is by this means that fraudulent votes are cast in so many places.[46]

45 In Portuguese slang, this practice was known as "mapism" ("mapismo").

46 Dantas, Tourinho. Díario do Congresso Nacional, October 27, 1994, p. 13,331

The initial decision to switch to electronic voting was made by President of the TSE, Minister Sepúlveda Pertence, in 1994. He cited the Rio de Janeiro scandal as a factor:

> After the experience we have lived through, not in the poorest regions, but rather in one of the most important cities in the country [Rio de Janeiro], we cannot retreat from the imperative of automation, or if that is not possible, the "mechanization" of the vote.

The impetus to change voting technologies came almost wholly from within the TSE, and was based in part on previous positive experiences with the use of technology in voter registration and results tabulation. When the decision was made between 1994 and 1995, there were no other major societal actors such as political parties, civil society organizations or other government bodies advocating for the abandonment of paper ballots.

In Brazil, a pilot was not carried out to test electronic voting. Instead, a gradual introduction of universal electronic voting was achieved over the course of three elections: in the 1996 elections, 30 percent of voters (33 million) directly voted through the electronic voting machines; in 1998, an additional 30 percent (35 million voters) voted through e-voting machines; and in the 2000 elections, the entire nation voted through electronic voting (100 million voters).

BUILDING THE SYSTEM FOR ELECTRONIC VOTING AND COUNTING

After Minister Carlos Velloso took over as President of the TSE at the end of 1994, he created a feasibility committee composed mostly of notable judges, lawyers and other jurists to investigate the feasibility of transitioning to electronic voting, as well as to determine the basic parameters of any new system. The committee was charged with planning a system with the following characteristics:

- Computers used for both voting and counting
- Could be used across a representative sample of municipalities throughout Brazil in the 1996 municipal elections
- Performed automatic and rapid tabulation of the votes
- Significantly reduced or eliminated fraud
- Implemented with the approval of citizens, political parties and candidates

While a judge formally led the committee, the real leader was Dr. Paulo César Bhering Camarão, a friend of Minister Velloso with expertise on the technical aspects of electronic voting. On technical aspects, the committee consulted with the military, government ministries and experts in universities. To study the legal feasibility of the new system, the committee also consulted the Bar Association (OAB), public prosecutor's office and other lawyers. Simultaneous to the formation of the feasibility committee, Minister Velloso worked to convince judges and technical staff within the TSE to accept the transition to electronic voting. In an interview, Minister Velloso indicated he had the support of President Fernando Henrique Cardoso and Minister of Planning and Budget José Serra. In the initial stages of planning, Congress and political parties had very little role, although they were kept informed. There was not much outreach to the media in the decision making stage, as Minister Velloso only held a press conference to inform the media about the TSE's efforts. There was also little civil society engagement in the decision making stage.

LEGAL FRAMEWORK

The TSE's feasibility committee crafted language to be included in legislation governing the 1996 municipal elections. Overall, the committee sought to create a system that would necessitate as few changes to existing law as possible. The legislature, with little debate, incorporated the legislative language into Articles 18, 19 and 20 of Law 9.100, which passed on September 29,

1995. The law authorized the TSE to use electronic voting, but did not specify in great detail how the system would work. The law required that voters choose a candidate by inputting their preferred candidate's number, and that each mayoral candidate's photo be displayed on the screen. The law also mandated that 120 days before the election, the TSE would allow political parties or companies hired by them to audit the code used in the machines. Finally, Law 9.100 mandated that a paper trail be created. A physical copy of the vote would be printed so the vote count produced by the machine could be checked using the hard copy. However, the law did not require that voters be able to verify the printed version of their vote with their selection on the machine.

Requirements for a voter verified paper audit trail (VVPAT) have undergone several reversals since the initial law governing electronic voting was passed. During this time, the TSE has been opposed to a requirement for VVPAT, but the Brazilian Congress has attempted to introduce this requirement several times. In 2002, Congress passed electoral law 10.408, which mandated that the TSE begin transitioning to a system with a voter verified paper audit trail (VVPAT) and that this be piloted in the 2002 national elections. The TSE argued that the pilot results suggested the VVPAT system increased error rates and re-introduced some of the problems associated with the paper system. Civil society advocates of VVPAT argue that the TSE failed to adequately train poll workers and educate voters about VVPAT, thus stacking the deck against it use.

In 2003, at the behest of the TSE, Congress passed law 1.503, which removed the requirement to adopt VVPAT, instead mandating that each machine record individual votes in a random order. This record would be given the parties so they could tabulate individual votes and check the official vote count. Of course, this digital registry of individual votes does not provide the same level of verifiability as the VVPAT, as voters have no means of verifying their vote.

In 2009, the status quo changed once again. Representatives of the Working Democratic Party (*Partido Democrático Trabalhista* or PDT) successfully included language in Law 12.034/09 passed that year, which once again mandated VVPAT by the 2014 elections. Further, the new law required that voting machines not be connected to the machines that verified voters' identity. The TSE challenged the law in the Supreme Court, which suspended the law on the grounds that if the voter identification machine and the voting machine were not connected, then it would be possible for a voter to vote multiple times. The Supreme Court also expressed concern that if the printer jammed, then polling station workers might see the vote while fixing the printer, compromising the secrecy of the ballot. While it is possible the suspension could be lifted on appeal, civil society activists in favor of VVPAT are not optimistic.

IMPLEMENTING OF ELECTRONIC VOTING AND COUNTING SINCE 1996

While the national TSE determines policy for the overall electoral process, state-level regional electoral courts (*Tribunal Regional Eleitoral* – TRE) implement the policy. Both the TSE and state TREs have high levels of project management capacity accumulated through decades of running Brazil's elections. Election operations are implemented by highly-qualified permanent staff and temporary workers (1.9 million for the 1996 elections). The vast majority of temporary workers in 1996 were poll workers and vote counters in municipalities that retained the paper ballot. In municipalities using electronic voting, the number of required workers was considerably smaller.

The TSE coordinated with the armed forces, the postal service and local governments to distribute voting machines and other materials. For technical assistance with the voting machines, the TSE contracted with a variety of companies. Firms hired in 1996, included HP, Oracle, Embratel, ABASE, MÓDULO and FUBRAS for services, including the creation and maintenance of databases;

preparation of EVMs; training of technicians; provision and support for use of flash cards; and security.

There were relatively few problems with electronic voting on Election Day in 1996. In the first round of the election, 74,127 electronic voting machines were used by about a third of the electorate and relatively few machines (3.65%) had some type of problem. According to the TSE, 1.76 percent of the machines had problems due to improper use, .92 percent had hardware malfunctions, .88 percent had software malfunctions and .09 percent had unidentified problems. The TSE noted the attached printers malfunctioned at unacceptably high rates, which contributed to the TSE's decision to abandon a printed paper trail in future elections. As a result of the printer problems, printed ballots were not used to verify any of the machine vote counts in 1996.

In subsequent years, the error rate has dropped even further. According to the TSE, The failure rate of EVMs is very low (about 0.007%), but if problems do occur, the machines are replaced. If replacement is not possible, then paper ballots are used. The only major logistical problems in subsequent elections occurred in 2008, where a flaw in the code caused widespread problems with a specific brand of memory flash card. In states where EVMs were using this brand of memory card, many voting machines had to be replaced on Election Day. In some cities, specifically Belém, Goiânia and Recife, roughly 30 percent of EVMs had to be replaced.

DESIGN REQUIREMENTS

In the initial design stage, the TSE feasibility commission determined the basic parameters of the new system. While the commission mostly consulted with stakeholders within the government, they also reached out to outside experts at several computer companies, including IBM, Hewlett Packard, ABC-Bull, CPM, Unisys, Microsoft, Digital and Soza International. Dr. Camarão also examined

existing commercial systems and observed elections in the state of Virginia in the U.S., which employed electronic voting. The committee concluded that existing systems developed in other countries were insufficiently tailored to the requirements of the Brazilian elections, and consequently decided to seek a custom solution.

The initial requirements of the TSE committee for the electronic voting machine were as follows:

- Easy installation process
- Easy to operate, both by voter and poll worker
- Low cost and ability to be adapted to other uses
- Own source of energy so that external power sources would not be required
- Robustness to different weather conditions
- Machine should be controlled by poll workers to prevent multiple voting
- Machine should have attached printer to enable paper trail
- Printer ballot should be collected automatically without any action by the voter
- Voting machine should not be connected to a network for security reasons
- Equipment should allow for future upgrades
- Screen should allow voter to verify their vote and be capable of presenting instructions
- Screen should display each candidate's photo
- Allow for ability of the voter to use an alphanumeric keyboard to select candidates; this requirement was later abandoned in favor of a purely numeric keyboard. The TSE thought that since knowledge of how to use telephone keypads was widespread, a numeric keypad would not pose any difficulties for the illiterate and semi-literate.

With regard to the procurement process, the initial requirements were as follows:

- Equipment needed to be provided with enough time to conduct a full battery of tests under diverse conditions.
- The company providing the machines had to have the technical and logistical capacity to fully meet the needs of the TSE.
- The contract would cover hardware provision, as well as technical support, logistical support and aid in distribution.

THE PROCUREMENT PROCESS

After the TSE feasibility committee issued its final report in August 1995, a new technical committee was convened to more thoroughly investigate and specify the requirements for the new system. They also elaborated the request for tender to be issued by the TSE. The request would specify how the machine would be developed; how many machines would be required and their geographic distribution; training requirements; technical support requirements; documentation requirements; and plans for testing the submitted models. Importantly, the committee was also charged with specifying how different bids would be evaluated.

To develop the request for tender, the technical committee first published a request for comments and suggestions on their requirements for the electronic voting machine in the government register. They received over a dozen reports from a variety of private companies, government entities and universities. With this information, the TSE technical committee wrote a complete request for tender with three annexes that specified the required products and services; the technical requirements of the voting machine; and how any bid would be judged. Procurement rules for government purchases were followed and all criteria for judging bids by companies were public.

Companies that submitted a bid had to provide a working model that could pass 96 technical tests. Only those companies that passed all the tests would be considered for the bid. Five companies submitted a bid, but only three companies—IBM, Unisys and Procomp—submitted models that passed the 96 tests. Of these three companies, Unisys submitted the lowest bid of R$ 69,762,178.60 (about $63 million USD) and was selected to implement the new system.

Since the 1996 elections, the TSE has continued to use outside contractors to maintain and manufacture the electronic voting machines. In the last several elections, Diebold-Procomp won bids to manufacture the voting machines. In 2009, Diebold-Procomp delivered 194,000 machines for use in the 2010 elections.

CERTIFICATION, SOURCE CODE REVIEW AND TESTING

In the elections held from 1996–2004, the code used in the electronic voting machines was developed by private sector firms. In the initial 1996 elections, Unisys contracted a company called Microbase to develop the software. Microbase used a proprietary operating system called "VirtuOs," whose code base was not generally available for auditing. In models developed for the 2002 and 2004 elections, Microbase used Windows CE as the operating system. In 2006, the TSE transferred software development to their internal team, and in 2008 adopted an operating system based on GNU/Linux.

The TSE reserves final authority over the source code, so no outside authority certified the code used in 1996 or in subsequent elections. The electoral law mandates the TSE make the final source code available to political parties and, after 2003, the Bar Association (Ordem dos Advogados do Brasil or OAB), 120 days before the election. Activists and academics say that that the TSE failed to comply with this requirement for the 1996, 1998 and 2000 elections. After 2000, in the wake of heightened scrutiny of the system, the TSE began to allow outside

actors to review the source code, but interviews with activists and congressional staffers indicate that only two parties – PDT and the Worker's Party (Partido dos Trabalhadores or PT) – regularly participated in the audits. PDT typically has computer scientists affiliated with the party examine the code, while PT hires an outside company. The OAB expended considerable effort and money prior to the 2004 elections to audit the code by hiring an outside company and examining the software in various states, but has only conducted minimal auditing since 2004 due to costs and lack of internal capacity. There has been criticism of this auditing process by civil society groups and computer scientists. Computer scientists criticize the fact that auditors must sign a non-disclosure agreement and, consequently, any problems found during the audit are not made public. Auditors also point out that only a few days are given for auditing, and the examination of code occurs in very controlled conditions on the TSE's computers, which is insufficient to comprehensively examine the code.

Academics and the OAB have also reported that there have been cases where the code has been modified after it was given to the parties, meaning parties did not audit the final version of the code. The TSE has argued the code needed to be modified for technical reasons, but has not fully explained the changes.

The first comprehensive, independent and nonpartisan audit of the full electronic voting system code and equipment was conducted several years after the adoption of electronic voting in 2001 and 2002 by eight computer scientists at the State University of Campinas (*Universidade Estadual de Campinas* or UNICAMP). The UNICAMP team concluded the system was "robust, secure, and trustworthy," and they made eight recommendations for improving the system. These recommendations focused on improving how the code is maintained and developed from election to election, as well as details of the cryptographic signing mechanism. According to the TSE, all recommendations made by the UNICAMP report were incorporated into the system after its publication. Since then, the TSE has sponsored a few additional independent

audits of the code, generally by university researchers. For example, a 2002 report by Jeroen van de Graaf and Ricardo Felipe, computer scientists at the Federal University of Minas Gerais and the Federal University of Santa Catarina, respectively, found the electronic voting system was an improvement over the paper ballot system. The authors, however, also criticized the time made available for political parties to audit the code. The researchers emphasized the limited utility of the cryptographic authentication safeguards, as there is no way for observers to know if it is functioning properly. Van der Graaf and Felipe argued for the use of a voter verified paper trail as a means of enhancing the audit ability of the system.

Beginning in 2009, the TSE organized public tests of the system, during which they invite computer scientists and interested parties ("hackers") to attempt to find external vulnerabilities in the electronic voting system. The first test in 2009 did not provide access to the voting machine code, while the 2012 test did. Participants in the 2012 test were given only three days to design, execute and evaluate attacks to the system. Further, access to the source code was limited, as only four computers with the source code were provided. Given the number of participants, this left limited time for each team to actually examine code. Basic tools to search and evaluate the code such as "grep" were also unavailable. The security tests focused solely on the voting machines, not other aspects of the system.

One of the teams that participated in the 2012 test succeeded in compromising the anonymity of the vote. After each election and for each machine, parties are provided with a list of individual votes cast (without identifying information of the voter) in a randomized order. The team of computer scientists from the University of Brasilia, led by Professor Diego Aranha, discovered a flaw in how individual votes were stored that would allow parties to recover the precise order in which votes were cast. According to the TSE, the vulnerability identified by Professor Aranha has now been fixed.

The TSE also allows for a form of auditing that they call the "parallel vote." The day before the election, two electronic voting machines in each state are randomly chosen for testing by representatives of the parties and the OAB. After the machines are selected, party and civil society representatives go to where the machine is located and bring them back to the state election headquarters. The observers can then test whether or not the machines are properly recording the votes being cast. According to the TSE, this parallel vote procedure has never found any irregularities or problems. Some computer scientists have criticized the parallel vote because it occurs a day before Election Day. According to these critics, it would be possible for manipulation of the system to occur between the time of the parallel vote and when Election Day begins.

SECURITY

The Brazilian electronic voting system has several software-based and design-based security safeguards. The EVM is designed to check whether or not the loaded software on each machine has a digital signature (hash) matching the signature provided by the TSE, and only continue to operate if the software verification is successful. Critics have pointed out that this verification process depends on the integrity of the verification software itself and, if this verification code is somehow compromised, then altered code could be loaded onto the machines.

To prevent access to the software and data of the EVMs, the contents of electronic voting machine are encrypted using an AES specification of 256 bits and the same key is used on all electronic voting machines. Critics in the computer science community argue that use of single key is risky because dissemination of the key would compromise all voting machines. The TSE defends the use of a single key because it makes the system less susceptible to a brute force attack. This risk is exacerbated by the fact that the encryption key is recorded in the source code. Since the source code is subject to audits by parties and the OAB prior to each election, the possibility exists that the key could be leaked and thus compromise the machines.

Another feature designed to safeguard the integrity of the vote count is the procedure by which machine vote totals are distributed. At the end of Election Day, the head poll worker ends the voting session and prints out six copies of the machine bulletin (Boletim de Urna). Five of these copies are distributed to the parties and one is posted at the precinct for the public. Theoretically, the parties or candidates could tabulate the totals from the printed machine bulletins and check the vote totals reported by the election authorities. Starting in the mid-2000s, electronic copies of machine bulletins were posted online and available to the public.

VOTER EDUCATION

The TSE hired private firms to conduct voter education for the first implementation of EVMs in 1996 through mass media including television, radio and print media. Local state courts were in charge of local campaigns, which included demonstrations of the new technology, lectures and mock elections. Civil society did not provide any voter education campaigns.

The TSE has continued the use of mass media as a voter education tool prior to all subsequent electoral events. Poll workers are also trained to help/support voters during voting. The machines are designed to facilitate voting for handicapped or marginalized groups. For example, the machines are equipped with earphones for deaf voters and the keypad has Braille. Poll workers are trained to explain the voting process to the voters, if necessary.

Opinion polling since 1996 has shown strong positive evaluations of EVMs. Local polling in 1996 showed high levels of awareness of the change in voting technology. In recent years, the TSE has hired independent polling firms to measure voters' evaluation of the system. According to the TSE, 94 percent of voters polled positively evaluated the electronic voting system.

ELECTION DAY PROCEDURES

Poll workers are responsible for organizing polling on the Election Day. They are responsible for the equipment and reserve equipment. Civil society groups generally do not observe Election Day procedures. Political parties, in contrast, send representatives to polling places. This practice is not universal, as not all parties have the size and organization to observe elections widely. Larger parties are more likely to have widespread observer representation at polling stations.

At 7.30 a.m. on Election Day, the president of the precinct turns on the e-voting machine in front of representatives of the parties, as well as the other poll workers. The e-voting machine prints out a report, called "zeresima," which certifies the ballot box is empty, i.e. that there is no candidate with a pre-assigned number of votes. No other tests at this stage of elections are allowed. Consequently, no reports are made. According to the political parties, their representatives at the polling locations do not have the technical capacity to check the system properly during Election Day.

Close-out procedures for Election Day are as follows:

- At 5:00 p.m. on Election Day, the president of the precinct uses his or her password to close the voting machine and print a voting machine report for the precinct. This report contains: precinct's identification code; voting machine's identification code; number of voters who attended and voted; and total voting results for each candidate.

- Five copies of the report are printed. These five copies are signed by the president of the precinct and representatives and inspectors of political parties. One copy is displayed announcing the results of the precinct. Three copies are sent to the Electoral Committee. The last copy is delivered to the Political Parties Committee. If required, the machine can print out five

additional copies that can be distributed to the district attorney of the political parties, representatives of the press and the public prosecution office. The copy delivered to the Political Parties Committee is extremely important, because it allows parties to check whether the data have been modified during transmission. Upon data reception, the TRE and the TSE send an electronic receipt to political parties.

- The voting machine program saves the data on a diskette in an encrypted format to prevent data modification. The diskette is delivered to the local electoral committee.[47]

In case of problems, each polling station has the additional reserve e-voting machines to replace the failed one. If no replacement voting machines are available, a paper ballot is used.

TABULATION

Once the polling is over and the polling place is closed, the data from the e-voting machine is then decrypted and uploaded with what is called a "guiding program." The process varies according to the type of election. In the case of municipal elections, the data is tabulated at the precinct of the municipality and transferred to the local TRE and the TSE. In the case of general elections, the data are read at the precinct that corresponds to the municipality and transmitted to the local TRE and to the TSE. The data on votes for the President of the Republic are added and announced by the TSE.

The entire system is ensured by a security infrastructure, which prevents data from being intentionally or unintentionally modified and/or deleted. The security of the system is comprised of the system audit program, which records

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all transactions performed on the machine, and the system security program, which prevents any tampering with the voting machine, such as the removal of the diskette on which election votes are stored.

CHALLENGES AND RECOUNTS

Since the implementation of electronic voting, no recounts of the results have been carried out due to the lack of a VVPAT. As a consequence, there have been no successful challenges of election results, and there have been no recounts carried out in Brazil. In cases were candidates have challenged results and asked for a comprehensive audit of the vote, the TSE has responded that the candidate would have to pay over $1 million USD to fund such a recount.

DEBATES OVER VVPAT

As discussed, there have been several legislative attempts to introduce VVPAT to voting machines, but each attempt has been strongly opposed by the TSE, and legislation has either been repealed or the courts have suspended implementation. While civil society and political parties are generally supportive of using VVPAT, the TSE's opposition has thus far blocked the introduction of VVPAT. As of late 2012, there is a reform initiative by some deputes on VVPAT is in the Chamber of Deputies but, overall, there are not strong advocates for VVPAT in the legislature. Given the strong opposition of the TSE, this may mean VVPAT will not be implemented in the near term.

There are many reasons for opposition to the VVPAT, including the cost of introducing this mechanism; the damage that might be caused to the paper and printer in the heat and humidity of many places in the country; and the voter secrecy implications, given that the individual and unique number of each voter would be printed.

There is a small movement in support of VVPAT in the social media space. An example of this type of initiative is a movement created by Ana Prudente called "Beyond the Electronic, I Want my Vote Printed" (*Quero Meu Voto Impresso, Além do Eletrônico*). These initiatives are not very influential, but interviews with stakeholders indicate the issue of VVPAT will return to the agenda of the legislature.

POST-ELECTION AUDITS AND EVALUATION OF THE SYSTEM

After each election, the TSE conducts an evaluation of system performance, but they are not conducted by independent bodies. The TSE is responsible for evaluating the system. Stakeholders have no formal role in the evaluation process. No public reports about the evaluation of the system have been issued. Even the political parties are not given reports about the process of elections by the TSE.

LESSONS LEARNED

Key findings and lessons learned from Brazil's experience are summarized here. They are organized according to the key issues and considerations outlined in the Overview of this guidebook.

Legality

- Although Congress formally creates the rules governing elections, the TSE is by far the most powerful actor in designing legislation governing elections. Usually when Congress has passed legislation contrary to the preferences of the TSE, the TSE has successfully convinced Congress to repeal the legislation or convinced the Supreme Court to suspend it.

- The institutional structure of election management in Brazil makes it difficult for external actors to independently influence and evaluate the use electronic voting. This stems from the fact that the TSE

both implements elections and adjudicates electoral disputes. This arrangement creates a clear conflict of interest, since the TSE's own actions are often involved in any disputes involving election technology. This problem is further exacerbated by the fact that the only judicial body higher than the TSE, the Supreme Court, is partly composed of ministers of the TSE. As a result of this institutional architecture, it is virtually impossible for outside actors to successfully challenge decisions made by the TSE through the legal system.

Accountability

- While the TSE has taken steps to make electronic voting accountable, these steps have not completely addressed issues of accountability.

- Robust forms of external auditing and evaluations are not provided. Opportunities to examine the source code or other aspects of the system are highly controlled and, given the complexity of the system, insufficient time is given for adequate vetting of the code and related systems.

- There is no practical way for political parties or candidates to dispute election outcomes, primarily due to the lack of VVPAT. Despite repeated attempts of congressional actors to modify the system to include a VVPAT, the TSE has successfully resisted such changes.

- Given these factors, some stakeholders have pointed out that greater access for non-governmental actors to examine or audit source codes would be beneficial for the election process in Brazil, and would enhance accountability of electronic voting.

Security and Secrecy

- In comparison to the paper ballot system, where fraud was relatively widespread, electronic voting has substantially improved the integrity

of the vote count. The vast majority of electorate and political elites view the system as reliable and trustworthy, although there are some exceptions, particularly in the academic community.

- However, the limits placed by the TSE on full audits of the source code, equipment, and election outcomes breed distrust amongst academics and civil society groups interested in government transparency.

- Critics of the system have pointed out several potential flaws with the encryption and software verification mechanisms, but the TSE rarely responds to these criticisms directly, which lowers trust in the system among interested parties.

- Most of the TSE's security efforts are aimed at protecting against an external attacker. Critics of the system argue that an internal attacker is also possible and that the TSE has not adequately described safeguards against such an attack.

- The voter verification system is linked to the voting machine, which is against international best practices. Congress attempted to sever this link through a change in the law, but the TSE succeeded in convincing the Supreme Court to suspend the law. The TSE argues the link is necessary to prevent voters from voting multiple times.

Transparency

- While the TSE states it is transparent during some parts of the electoral process, this is not always sufficient in meeting international best practices and gaining the trust and confidence of key stakeholders.

- In some cases, transparency was restricted because of sensitivity and secrecy of information, particularly with regard to access source code.