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# Success Implementation of E-Voting Technology In various Countries: A Review

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**Abstract**

Electronic voting or known as e-voting is a technology developed for voting. The use of e-voting in the general election has been widely implemented. Some countries that have successfully implemented it are India, Brazil, Estonia and the Philippines, and other countries that have unsuccessfully tried or canceled to implement it are Argentina, United States, Belgium, Canada, Japan. Mexico, France, Peru, Australia, Costa Rica, Finland, Guatemala, United Kingdom, Ireland, Italy, Kazakhstan, Netherland, Germany, Paraguay, Norway, Switzerland and others. In this study, we tried to present countries that have successfully implemented e-voting, analyzed them, and made conclusions upon the analysis. The result of this study is that the adoption of e-voting is not only about technology. Many factors are no less important that contribute to the successful implementation of e-voting in a country, so that other countries that plan to implement e-voting in the future can learn from the success of these countries.

*Keywords: e-voting, general election, election technology*

## 1. Introduction

Election is an activity that is prevalent in countries that adhere to a democratic system that is usually carried out to elect State leaders, regional leaders, and the representatives in parliament. By the complexity of electoral procedures, the increasing number of voters, especially if the country is an archipelagic country with many remote populations, make the things above become its own problems, such as: expensive costs, slow recapitulation of election results, security problem, etc.

Indonesia is a sample of the third largest democratic country, which in 2019 has conducted elections for members of parliament, and also its leader of the Country. According to several sources, the number of voters was 192 million, the number of polling stations was 813,350 units, and the number of committees assigned to polling stations was more than 7 million people, and also it spent more than 25 trillion rupiahs of budget. This number definitely an enormous cost for developing countries, not to mention common problems, such as: ballot distribution and tiered calculations that require a relatively long time.

Technology is the solution to the problems that arise in conventional elections and technology is the only solution (Liu and Zhao, 2018). Many countries have implemented e-voting technology, such as: Argentina, United States, Belgium, Canada, Japan, Mexico, France, Peru, Australia, Costa Rica, Finland, Guatemala, United Kingdom, Ireland, Italy, Kazakhstan, Netherland, Germany, Paraguay and others (Budurushi, Jöris and Volkamer, 2014) (Esteve, (Esteve, Goldsmith and Turner, 2012), (Goretta *et al.*, 2019). However, among those countries mentioned, only a few countries that have succeeded and successfully implemented it. Some of them ended with cancellation, only did some try-outs, did the program partially, did not continue it, and other reasons.

In this study, we tried to present the countries that have successfully implemented e-voting as an example for other countries that will implement e-voting technology in the future so that in future implementation, it does not end in failure.

## 2. Literature review

Electronic voting or e-voting is an election activity with the support of technology. The voting is not done by punching a hole in the paper, but the voters vote by machine, and the ballots are stored in digital form (Kumar *et al.*, 2011). E-voting is an election activity in which the recording and the counting of votes are carried out using electronic media (AdelekeR. *et al.*, 2013). Electronic voting machines were intended to reduce errors and speed up the counting process. The advantages of e-voting over conventional systems or ballots according to (Kumar *et al.*, 2011) and (Riera and Brown, 2003) are:

- Eliminating the possibility of invalid and questionable votes, which in many cases are the causes of controversy in elections.
- Making the vote counting process much faster and more accurate than conventional systems.
- Reducing the amount of paper used is environmentally friendly
- Reducing printing, distribution and committee costs

We summarized the countries that carried out e-voting according to their status (Goretta *et al.*, 2019) as follows:

**Table 1: List of countries**

| No. | Status | Country |
|---|---|---|
| 1 | Countries that have implemented e-voting completely | India, Brazil, Philippines, and Estonia |
| 2. | Countries that have implemented e-voting partially | Argentina, United States, Belgium, Canada, Japan. Mexico, France and Peru |
| 3 | Countries that cancelled the implementation after conducting try outs of e-voting | Australia, Costa Rica, Finland, Guatemala, United Kingdom, Ireland, Italia, Kazakhstan, and Norwegian |
| 4 | Countries that did not continues the implementation of e-voting | Netherland, Germany and Paraguay |
| 5 | Countries that are in the process of Testing e-voting | Bangladesh, Bhutan, Ecuador, Mongolia, Switzerland, Nepal and Indonesia |

In the table above, we can see that there are many countries which implemented e-voting only limited to trial or partial trials, even many of them cancelled the program or did not continue it. Many developed countries that carried out e-voting, but then did not continue it, like the United Kingdom, was claimed by the digital advocacy groups that the implementation of e-voting in their countries is not valid and cannot be trusted (Vassil *et al.*, 2016). Netherland faced widespread resistance from legislators and the public because the e-voting technology used was untrusted (Loeber, 2008). The possibility of privacy, verification, and confidentiality is part of important elements in the implementation of e-voting (Aljarrah, Elrehail and Aababneh, 2016).

We present the countries that were successfully implemented the e-voting below, they are:

### *2.1 India*

India is the largest democratic country in the world, which began the experiment of the use of e-voting for its 16 states in 1989-1990 in Madhya Pradesh, Rajasthan and the Capital of Delhi. The e-voting pilot project in India actually has been started since 1982 on a limited basis (Wolchok *et al.*, 2010), but the Assembly in the State of Kerala canceled it, because it was not in accordance with the law. However, later on, India changed the state law that arrange and ratified the election using e-voting technology. Therefore, since 2003 in India, all states have already used e-voting technology for elections. In 2014, the voters in India were registered as 814 million and there were 930 thousand polling stations using Electronic Voting Machines (EVM). Initially, the e-voting machine in India consisted of two units, namely the voting machine and the control unit. The voting machine is stored in the voting booth and the control unit is kept within the authority of the voting officer. However, started from the 2014 elections, the voting machine has been added by the existence of a VVPAT (Voter Verifiable Paper Audit Trail) machine, in which this machine has the function to print the ballot papers chosen by the voters which can be counted manually if desired. All of the e-voting equipment do not depend on electricity supply, internet, WIFI

or USB. The pictures of EVM and VVPAT machines can be seen in Figure 1, taken from the election commission of India website (eci.gov.in)


**Fig. 1: EVM and VVPAT Machine**

## *2.2 Brazil*

Electronic elections in Brazil began partially in 2006 at local elections in the city of Santa Catarina, after the Supreme Court of Brazil approved it. Started in 2000, the Brazilian government began to convert the entire electoral process using e-voting, after conducting a feasibility study (Kumar *et al.*, 2011). At the time of the election, Brazil installed 400,000 e-voting machines in the form of kiosks, installed at the center of the crowd and offices. The machine consists of two parts: one part for the control unit installed in the officer's office, and the other part of the machine stored in the voting booth displaying candidates on the screen and voters vote with the help of an integrated keyboard (Everett *et al.*, 2008). For audit purposes, since the beginning Brazil used e-voting, the ballots will come out through a paper ballot machine (VVPAT). The forms of e-voting used in this country can be seen in Figure 2 below.


**Fig. 2: e-voting machine in brazil**

## *2.3 Philipines*

The Philippines is the closest neighboring country which have applied the technology and information in the electoral process, especially at the voting and counting stages. The Philippines first applied IT in the stages of voting and counting, in the 2010 elections. In preparation for the holding of the General Elections in May 2010, the Philippine election committee (COMELEC) issued general instructions on voting, vote counting, and sending process of the votes at the polling stations. Another procedure, including the regulation of disputes over the results of E-Voting, were also issued.

COMELEC chose PCOS (Filipino e-voting system) to be used in the 2010 elections. The PCOS system is a vote counting system based on OMR (Optical Mark Recognition) technology. Each PCOS machine was equipped with a memory card and i-Button, so that only certain ballots from a polling station can be scanned. Ballots marked by the voters were inserted into the PCOS machine to be scanned. This PCOS machine read the sign made by the voters, when the polling station was closed. The PCOS machine printed the voting report at the polling station with information about the number of votes of each candidate, and sent the results to the tabulation office at the city or district level, thus the election in the Philippines still used ballots or papers. Voters came to the polling station and were given a ballot, then, voters gave their choice marks on the ballots that have been provided.

The adoption of E-Counting with this PCOS machine was considered to be unsuccessful, by some people. In fact, one of the most influential election observers in the Philippines, AES, called the 2013 election as a "technological and political disaster" election, because of some controversy surrounding the holding of the 2013 elections.

### *2.4 Estonia*

Estonia began using e-voting in its general elections in 2007. In fact, the e-voting project in the country began in 2003. Estonia was the first country that use the internet in e-voting, and in 2011, Estonia also used mobile phones in the conduct of e-voting (Tsahkna, 2013). The mobile phone is considered as an identity card with the SIM Card number as the voter's identification, and at the same time the voter must be in front of a computer that uses internet connection for the selection process (Mpekoa and Van Greunen, 2017).

## 3. Discussion

By the information presented in the literature above, we made the following table:

**Table 2: Comparison e-voting technology**

| **Countries Technology** | **India** | **Brazil** | **Philippines** | **Estonia** |
|---|---|---|---|---|
| Hardware | EVM (Electronic Voting Machine) | GX-1 Integrated Processor | PCOS | None / Gadget voters /internet voting |
| Paper Audit Trail | VVPAT Machine | VVPAT Machine | Yes (conventional ballot) | Yes (Digital Receipt) |
| Internet connection | None | None | Yes (only for counting) | Yes |
| Wi-Fi / USB | None | None | Yes (only for counting) | Yes |
| Power | Battery | battery | Battery and electric | Battery and electric |
| Result | Success, No problem | Success, No problem | Success but many negative comments / claims from the public | Success but many negative comments / claims from the public |

In the next step, we tried to compare the social, political, and economic studies of the countries that successfully carried out e-voting with the results as described below:

**Table 3: Social, politic and economic status**

| **Countries Status** | **India** | **Brazil** | **Philippines** | **Estonia** |
|---|---|---|---|---|
| Economic Status | Developing country | Developing country | Developing country | Developed county |
| Sum of voters | 814.000.000 | 140.000.000 | 54.000.000 | 176.000 |
| e-voting constitution | Yes | Yes | Yes | Yes |
| Trial Process | Yes | Yes | Yes | Yes |
| Feasibility study | Yes | Yes | Yes | Yes |

From the two tables above, it can be concluded that:

- Only Countries that used microcomputer devices without an internet connection that successfully carried out e-voting seamlessly (India and Brazil).
- Countries that used internet connections and successfully carried out the e-voting, but were not smoothly conducted it, got many negative comments from the people of the countries. It also created concerns among the people, especially about privacy, verification and confidentiality (Aljarrah, Elrehail and Aababneh, 2016).
- Most developing countries have successfully implemented e-voting.
- All countries that successfully carried out e-voting, have carried out trials, feasibility studies and have a strong legal support (Hapsara, 2013).

## 4. Conclusion

E-voting technology is an important factor in the implementation of e-voting in a country (Hapsara, 2016), but it is not the only thing that influences the success of its implementation. There are many other factors, such as: the readiness of voters and electoral committees, public trust, readiness of the constitution and others (Adeshina and Ojo, 2017), (Aljarrah, Elrehail and Aababneh, 2016), (Avgerou, 2013), (Alomari, 2016). In the future, it is better to conduct a review study on the countries that failed or cancelled in carrying out e-voting, because until now there is relatively a large gap of the ratio between the failing and the successful countries. Another studies that is no less important, is the necessity of having a framework study development (AboSamra *et al.*, 2017), (Hapsara, 2014) for the implementation of e-voting at the national level of all countries.

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