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Challenges in Implementing Electronic Voting (e-voting) in Pakistan

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Abstract

Implementing electronic voting (e-voting) within Pakistan faces multiple barriers from various technical, social, and institutional components. This research bases its approach on the interpretive research paradigm to study e-voting adoption barriers using thematic analysis on 30 expert interviews. Eight dominant conceptual groupings from the collected data identified the main challenges people faced during this transitional phase. The scarcity of resources and inadequate infrastructure barriers impede mainly those communities that remain underdeveloped in rural areas. Implementing e-voting remains difficult since inconsistent electrical supply and inadequate internet connectivity function as environmental barriers. Data security vulnerabilities and suspected cyber threats make substantial security risks the most significant impediment regarding the electronic voting system. The system fails to gain trust because it requires a set of institutions to regulate it properly. High operational costs and financial expenses limit the feasibility of adopting e-voting systems for investment. The absence of relevant social group consultation during decision-making processes creates a social group exclusion in the decision-making process. The general public resists new technology systems because they do not understand technical matters sufficiently. Before elections, the implementation process requires strict time constraints from e-voting systems, which generate added pressure on this complex procedure. E-voting adoption in Pakistan needs secure system development, ability-building among stakeholders, and broad involvement of affected parties to implement modern voting technology successfully. This research confirms that Pakistan requires extensive strategies to bring e-voting systems because existing problems need specific solutions beforehand.

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Introduction

India, Japan, the United States, Brazil, and South Korea have adopted e-voting systems to safeguard voting and improve process organization. DRE operates as an e-voting machine in India (Chauhan et al., 2018). Voting through electronic methods relies on computers, smartphones, or assorted electronics to transmit votes. Pan et al. (2012) demonstrated that e-voting provides higher reliability than conventional voting systems, while Musa and Aliyu (2013) showed that results calculation happens more quickly with e-voting. Electronic voting receives support from Rosacker and Rosacker (2020), who assert distances voting rights because of the dangers manual balloting faces during impromptu situations like COVID-19. Rosacker and Rosacker (2020) demonstrated that electronic voting follows the trend of cell phone adoption. The expanding nature of cultures demands investigation regarding e-voting advancement to understand its position as the primary voting method (Darmawan, 2021).

Table 1: e-voting Adoption and Implementation

No.	Status	Country
1	Complete adoption and implemented e-voting	Brazil, India, Estonia, and the Philippines,
2	Partially adopted and implemented e-voting	United States, Argentina, Belgium, Japan, Canada, Mexico, Peru, and France
3	Canceled the implementation after conducting trials of e-voting	Costa Rica, Australia, Finland, United Kingdom, Guatemala, Ireland, Kazakhstan, Italians, and Norwegians
4	Did not endure the adoption and implementation of e-voting	Germany, Netherlands, and Paraguay
5	In the process of testing e-voting	Bhutan, Bangladesh, Ecuador, Switzerland, Mongolia, Indonesia, and Nepal

Source: Risnanto, Rahim, Herman & Rohman (2020, 3281)

Pakistani e-Voting: Adoption and Implementation

The ECP created the 2010 "Use of Electronic Voting Machines (EVMs) in Pakistan" Commission to investigate candidates' political, legal, and financial histories. That panel suggested voting law changes. The National Assembly changed electoral legislation with the 2017 Elections Act (Haq & Ali, 2022). The Elections (Second Amendment) Ordinance 2021 authorized the ECP to acquire EVMs and permitted foreign expats and Pakistanis abroad to vote electronically in the 2023 general elections. New Sections 94 and 103 mandate overseas Pakistanis to use electronic voting equipment. Pakistan's National Assembly and Senate passed the Amendment Ordinance 2021 (The Express Tribune, June 19, 2021).

Electronic voting machines were considered by The Election Commission of Pakistan in 2009. It suggests using "electronic voting and counting methods" more (2010). National implementation of these technologies is still being determined. The ECP demanded the display of Indian EVMs in 2011 but declined due to potential controversy (India Times, 2011). ECP also sought quotes from manufacturers to build the EVM according to the design. TIP, KRL, NIE, Smartmatic, Indra, and COMSATS introduced their EVM models. The 2012 Multan byelections tested the COMSATS-proposed EVM (Jafri, 2012).

ECP said in 2014 that it would employ EVMs within a few years. It showed political organizations' and media outlets' EVM prototypes at a special event. After asking the ECP for tangible and secure EVM ideas, the Parliamentary Committee on Electoral Reforms (PCER) saw a demonstration. The Election Commission of Pakistan (ECP) tested biometric voting machines (BVM) EVMs in the 2015 NA-19 byelections in Haripur. The machines verified 15,723 BVM votes. Invalid or blocked CNICs, worn fingerprints, and NADRA-unavailable fingerprints caused unsuccessful confirmations (Sadaqat, 2015). After the 2017 Election Act, NA-4 bye-elections were the first to employ EVMs. ECP authorities will use over 100 electronic voting machines in 100 polling booths at 35 locations (Imran & Bari, 2017). Unfortunately, the test run information is missing. The ECP pursued Smartmatic's pricey electronic voting machines (EVMs) (Haq & Ali. 2022).

The previous PTI government had also requested that foreigners vote for an extended period. In response to Supreme Court orders in early 2018, NADRA spent ten weeks and Rs. 150 million establishing an Internet Voting (IV) Network for overseas Pakistanis (Bhatti, 2018). A Supreme Court-appointed IETF (Internet

Voting Taskforce, 2018) audited iVote technology and found security issues that barred its implementation in the 2018 General Elections. In October 2018, 35 constituencies tested the system in byelections. December 2018 saw a second trial program using district byelections. Both pilots' foreign ballots were counted. This deployment cost Rs. 95 million (Election Commission of Pakistan, 2018). In the first month of 2019, the NA and Senate received details of the EVM test program (Haq & Ali. 2022).

Despite postponing their parliamentary discussion for two years, the prime minister ordered the Ministry of Information Technology (MoIT) to hire Minsaitas' expert to study the nation's electronic voting system in 2021. The Spanish corporation shared IVTF concerns. In its report, the IVTF recommended implementing the IVTF recommendations to improve the online voting method (Minsait, 2021). To "Ensure impartial and free voting," the 2020 PTI administration suggested electronic voting. After the 2021 senatorial elections, administration-ECP tensions increased. Without opposition or ECP consultation, President Arif Alvi altered Sections 94 and 103 of the Elections Act 2017 by decree. This reform requires the ECP to use EVMs for nationwide elections and allow abroad Pakistanis to vote (Naqvi & Lodhi, 2021). Critics of the decision cited the 2018 Outcomes Transmission System (RTS) disaster as evidence that technology may alter future election outcomes (Chaudhry, 2021).

The ECP needs to strengthen its technology use since it must buy EVMs before knowing if they would prevent manipulation, and Pakistanis abroad can vote immaturely online. The ECP is concerned that strengthening NADRA's monitoring of electoral document generation may reduce its autonomy and transfer over constitutionally mandated functions to NADRA. A technical committee from the ECP will evaluate the EVM proposal in terms of its technological, legal, and financial aspects (Khan et al., 2021).

Methods and Materials

The 30 experts, academics, and researchers interviewed to explain the Study's Model are A-1 through A-10, B-1 through B-10, and C-1 through C-10. Tables show data in two rows and three columns. The first column lists semi-structured interview questions, the second participants' responses, and the third researchers' opinions.

Findings and Discussion

Table 2: Data Analysis - Challenges

Theme	**Challenges in Implementing e-voting in Pakistan**	
Questions	Summary of the Interviewees' Responses	Interpretation
Q. 1: What kind of challenges are faced by Pakistan in implementing the e-voting system in Pakistan?	Interviewees of group A: "*The respondents of this group highlighted these challenges:* **1.** Resource and infrastructure; **2.** Security of the Electronic Voting System; **3.** Lack of Involvement of Affected Societies, and **4.** People's General Ignorance of Technology." Interviewees of the group B: "*The respondents of this group highlighted these challenges:* 1. Technological issues; High Costs; 2. Security of the Electronic Voting System; and 3. Environment factor." *Interviewees of the group C: "The respondents of this group highlighted these challenges:* *1.* Environment factor; *2.* Regulatory Framework;	This study examined Pakistan's e-voting problems. Academics, researchers, and specialists provided opinions. All participants mentioned these issues during researcher interviews: ***1.*** *Resource and infrastructure* ***2.*** *Environment factor* ***3.*** *Security of the Electronic Voting System* ***4.*** *Institutional and Regulatory Framework* ***5.*** *Change Comes at a High Cost* ***6.*** *Absence of Consultation with the Relevant Social Groups (RSGs)* ***7.*** *Lack of Technological Awareness in the Society* ***8.*** *Time Restrictions*

	3. Time Restrictions"	

Source: Table Produced by the researcher

Challenges in Implementing e-voting in Pakistan

Results showed that technology's usefulness, convenience, users' confidence, resources, and environment all mattered. These criteria were based on questionnaire and conversation themes.

Resource and infrastructure

Due to infrastructure issues, few dependable internet connections or alternative technologies facilitate e-voting in Pakistan (Kamran, 2024). This could make voting safer and less reliable. E-voting requires a robust network, which Pakistan must improve (Kamran, 2024). A very small percentage of population in the country has Internet and dependable broadband connections, making e-voting difficult (Zada, Falzon, & Kwan, 2016). This growing nation needs more technology to support e-voting. Online voting requires better broadband infrastructure, and many people need computers and the Internet, which is a concern (Heblich, 2016). E-voting technologies are unreliable since the nation's electrical system requires improvement, and power outages are expected (Aboelazm, 2023). Last, people need to trust the authorities and their agencies more, making selling e-voting challenging (Kassen, 2020).

Environmental factors

Pakistan's infrastructure needs improvement, making e-voting difficult for the environment (Kamran, 2024). The absence of a trustworthy and safe internet, computer access, and electricity are significant issues (Mogadem, Li, & Meheretie, 2022). Citizens' lack of understanding and technological expertise might also delay e-voting implementation (Kassen, 2020). The country's cultural values and significant illiteracy make e-voting difficult. Lack of government funding and support are major obstacles to implementing e-voting in Pakistan (Kamran, 2024). The interview findings also demonstrated that the setting of a suggested innovation may affect its adoption confirming Oduro's findings (Oduro, 2020). The interviews showed that the IEC must evaluate the political context and public environment before using electronic voting (Maphephe,

Balkaran, Thakur, & Fagbola, 2020). The IEC's decision to adopt electronic voting will depend on its approval in both situations (Scheepers, 2022).

Ensuring the Security of the Electronic Voting System

Security is paramount when establishing e-voting in Pakistan (Kamran, 2024). A system hack or other manipulation could alter outcomes (Hu, Immorlica, & Vaughan, 2019, January). The voting system has to be secure enough to track and verify each vote. Hacking, information incidents, and various other threats plague e-voting. Pakistan may need more extraordinary security measures to ensure safe and reliable polling. E-voting risks include data security and voting integrity (Qasim, Vyshniakov, Khlaponin, & Poltorak, 2021). Pakistan's infrastructure needs to be secure to secure data and votes. Even though Pakistan's intended electronic system will not be online, hacking remains a significant issue. The advanced malware Stuxnet targeted Iran's Nuclear-Weapons Program offline. Pakistan, one of the least computer-secure nations, may need help to defend its e-voting system from similar threats (Siddiqui, Sohu, & Zardari, 2023).

Unresolved Problems in the Existing Institutional and Regulatory Structure

The Pakistani government needs to finalize e-voting and other digital election laws. A secure legal structure for electronic voting has rendered citizens and politicians uneasy. E-voting and additional technological innovations in polls require a safe IT infrastructure from the government. The need for more awareness of the advantages of e-voting, along with other technological advances in elections, is another major obstacle to its success in Pakistan. Pakistan's political process has used ballots made of paper for a while, and electronic voting would require new laws. The ECP may mediate a power conflict amongst government agencies because of the changing election modes and processes, even if this violates its mandate under the constitution (Rahman et al., 2021).

Change Comes at a High Cost

Pakistan is a developing nation with less sophisticated infrastructure and technology, making e-voting costly for the administration. Pakistan must also address understanding and trust in technology, resources, and security issues before implementing e-voting. There is need to research and evaluate the costs of creating and delivering an EVM in Pakistan before completing a cost-benefit analysis and determining whether to set one up. Foreign and domestic pressures put the government in a bind. The substantial surge in essentials prices following

COVID-19 disproves the federal government's plan to employ e-voting in upcoming elections (Rahman et al., 2021).

Lack of Involvement of Relevant Social Groups (RSGs)

Lack of interaction with crucial community segments is a significant issue for implementing e-voting in Pakistan, even though many parties might need to comprehend it (Haq & Ali, 2022, March). Thus, they could be required to understand the technology's pros and cons. The procedure may require more trust because of an absence of comprehension and information. This may reduce public support and adoption. Consulting the correct people may need additional funds or people to implement the technology. Pakistan's election commission and opposition parties consulted after utilizing EVMs (Hamida Bibi & Khan, 2022). Opposition leaders have complained to the administration about election transparency and fairness (Louw-Vaudran, 2019). Unfortunately, the administration has ignored them.

Lack of Technological Awareness in the Society

Pakistan's most significant issue with e-voting is technology literacy. Even while the country has increased internet and mobile phone use, many people need the skills to use them. E-voting is difficult without technical understanding and access to technology (Hapsara, Imran, & Turner, 2017). In developing nations, e-voting systems are expensive and difficult to set up, making them difficult to utilize (Arnob, Sarker, Haque, & Sarwar, 2020). Pakistanis must understand and use technology before e-voting (Idrees, 2024).

Time Restrictions

Because internet availability in Pakistan is inconsistent, real-time e-voting would be challenging to implement. Pakistan has a long tradition of election manipulation and fraud, raising worries regarding voting system security and integrity. E-voting requires additional technological infrastructure, making it difficult to set up rapidly. Finally, the restricted duration of e-voting would require the government to give all voters enough time to vote (Rahman et al., 2021).

Political Unrest and Political Will

Many sections of the country experienced political turmoil and bloodshed, which could hinder electronic voting. E-voting requires more infrastructure and money in Pakistan, a developing nation, which might make election security and accuracy difficult. There must be more confidence in the authorities and election

process to ensure e-voting. Pakistan's political instability could hinder e-voting. Political instability may discourage e-voting, lowering voter turnout.

Discussion

Pakistan has explored electronic voting (e-voting) to enhance electoral transparency and efficiency, but significant challenges persist. According to Khan et al. (2020), who conducted a Thematic Analysis of 30 professionals, Pakistan faces financial and infrastructural constraints, especially in remote areas. Political instability, socio-cultural dynamics, and electoral fraud create public mistrust, while security concerns—like hacking and ballot tampering—raise doubts about system reliability (Khan et al., 2020). Institutional weaknesses hinder implementation, such as unclear procedures and lack of an independent regulatory body. The high cost of transitioning to e-voting includes equipment purchases and public training programs. Significantly, excluding relevant social groups—such as women, minorities, and disabled persons—affects inclusive participation (Khan et al., 2020). Limited technological awareness leads to confusion and errors, especially in rural areas.

Additionally, strict election timelines pose logistical challenges, as e-voting setup requires training, testing, and troubleshooting time. Khan et al. (2020) conclude that key barriers include inadequate resources, security risks, regulatory gaps, lack of stakeholder consultation, low-tech literacy, and time constraints. Overcoming these requires robust planning, inclusive dialogue, and a strong regulatory framework.

Challenges

- **Resource and infrastructure**

Developing proper electronic voting requires systematic expansion of infrastructure and supplementary resources. Implementing e-voting in Pakistan requires substantial infrastructure and resources. Implemented systems require both technically sound infrastructure and qualified personnel and secure, dependable, affordable services. Comprehensive infrastructure development must exist to guarantee proper safety features and reliability throughout this framework. The computer system requires dedicated secure housing units linked through protected networks and reliable power supply facilities. To protect human rights effectively, the system requires both proper laws and standards of operation. Educational and participatory programs enable people to understand and trust the system's voting results.

- **Environmental factor**

Power instability and minimally reliable systems prevent Pakistan from developing electronic voting systems that protect the environment. The power supply is unreliable due to frequent outages, which could disrupt voting procedures. The combination of current computing systems and web technologies with hardware components makes it difficult for Pakistan to deploy reliable voting solutions. Electronic voting faces significant difficulties because of the issues preventing secure, precise, and reliable implementation. The Pakistani public lacks trust in the electoral system because of corruption and election fraud combinations, which may stop electronic voting from being implemented in Pakistan. The findings of Krimmer & Volkamer (2006), Groenendaal & Lamberts (2008), Brown, Salomon & Thompson (2007), Voas & Tuerk (2008) and Sadeh & Rosenberg (2009) support each other.

- **Ensuring the Security of the Electronic Voting System**

The absence of proper cybersecurity measures blocks the installation of e-voting in Pakistan today. Electronic voting system integrity needs strong security protocols that are essential for appropriate implementation. Upgrading security demands the protection of digital data against unauthorised accessibility and harmful modifications as priority elements. A reliable external authority must verify user identification before approval of system entry. System access can be secured through combination methods that utilise passwords or biometric identification such as fingerprints and facial recognition. The system enables entry only to authorised personnel. Roles and responsibilities should determine the system permissions users can access—this process needs auditing as the fourth step. System monitoring functions should track and save every system action from detecting unusual activities and analysing suspicious behaviour patterns. Fifth, firewalls. The system remains secure because firewalls keep unauthorised hackers from accessing it. Firewalls protect against security threats when deployed with the correct settings, preventing software viruses and hackers from entering a system. The sixth step involves testing and utilising backup and recovery strategies as key methods to combat damaging attacks on the system. Conduct security inspections before updating the entire system. Kaman, Yousaf and Latif 2016, along with Khan and Khan 2018, Arif et al. 2015, Asim and Jabeen 2015 and Shehzad and Arshad 2017, published studies with similar findings.

- **Issues with the Institutional and Regulatory Framework**

The electronic voting system in Pakistan needs new legislation to activate. Lower House members of the Pakistani Electoral Commission issue backing for computerised voting systems. The recommended legislative framework shall protect voting security while maintaining its correctness and intactness due to its established legislation. Under this framework, every citizen would have equal voting rights regardless of age limitations, gender status, or inability to vote. The proposed digital framework will establish a secure electoral infrastructure that guarantees elections' integrity and truth. The voting system uses cryptography methods, secure servers, and biometric identification protocols. A policy structure enables voters to observe the transparency of the election process. The policies establish measures that prevent tampering with voting procedures. An integrated framework contains training sessions which help eligible voters identify the voting process. These include voter education programs. The Election Commission of Pakistan can build an electronic voting framework that ensures both reliability and security together with integrity safeguards. Three research works explored the same matter, including Rafael et al. (2015), Krimmer et al. (2015), and Pentikousi (2016).

- **Change Comes at a High Cost**

Pakistan requires infrastructure, expert technical support, and financial funding to establish e-voting. Electronic voting requires secure servers joined with voting machines and multiple hardware and software elements. Qualified workers must maintain and manage the system at the operation level. Sections on training demand extensive capital allocations and prolonged time commitments. Ahmadi, Fard, & Fard (2015) and Soomro (2020) analysed this topic.

- **Absence of Consultation with the Relevant Social Groups (RSGs)**

The high level of interaction among social groups in Pakistan is a major hindrance to computerised voting systems. Electronic voting systems need increased Internet connectivity across the country to ensure the security and efficiency of voting procedures. Counting all eligible voters together with independent result verification requires systematic effort. Dhillon and Tambuwala (2012), Reeves (2015), Brown (2020), and Convery et al. (2017) all addressed the study topic.

- **Lack of Technological Awareness in the Society**

The lack of understanding of technology among Pakistanis creates difficulties when using computerised voting systems. The nation's population needs guidance about the electronic voting procedure and its advantages since it remains a novel practice in Pakistan. Limited awareness about electronic voting will require thorough educational efforts before people can accept its advantages. Public engagement success remains critical for the spread of e-voting knowledge among the population. Training sessions about education combined with basic discussions demonstrate the potential and benefits of electronic voting methods. Future voters need education about electronic voting systems for machine usage during registration and verification. Mangal & Bhardwaj (2018) and Iacovou et al. (2012) and Wegrzyn (2015), together with Zhang & Pardo (2013), explored this matter.

- **Time Restrictions**

The compressed duration for electronic voting in Pakistan results in various setbacks. Electronic voting across the nation needs additional basic infrastructure before implementation. The country lacks any standard electronic voting system that covers the entire nation. We must achieve tampering prevention and vote security alongside other requirements. Implementing electronic voting requires large-scale monetary spending coupled with extensive human resource involvement. We need to establish safe and effective methods for voter registration and voter eligibility confirmation. The widespread acceptance of electronic voting depends on social reception, as many people need to understand its foundation. Four researchers, Herrmann & Johnson (2013), López-González & Ochoa (2012), Mavridou & Vassilakopoulou (2010), and McBurnett & Herrmann (2010), studied the issue.

Conclusion

Implementing electronic voting in Pakistan encounters various barriers because of weak infrastructure, limited internet connectivity, security issues, and inadequate regulatory monitoring. Expert research emphasised eight primary obstacles: insufficient rural funding, weak cybersecurity practices, resource limitations in rural Pakistan, and systematic avoidance of relevant social groups (RSGs). The combination of low-tech management capabilities and short deadlines makes challenges even more complex. Pakistan must build infrastructure while improving cybersecurity and including stakeholder involvement, particularly targeting the RSGs and establishing education and

awareness initiatives to succeed. Deliberate, phased implementation is necessary to build up an e-voting system that remains transparent and includes every stakeholder.

Recommendations for Future Research

Based on the findings, the paper identifies the following state responsibilities:

- **Voting Systems Protected by Bitcoin Technology**

Through encryption, Bitcoin strengthens security while maintaining privacy during online voting and boosting trust in the process. BitVote represents a product of Coin Sciences Ltd that achieves secure online voting through identity protection and result verification. Research shows that Bitcoin use may decrease spending while boosting electronic voting system reliability among the public.

- **Close the Loopholes in the Regulatory System**

The existing electronic voting regulatory system is confusing. The present legislative framework needs modernisation through a combined effort to update rules with the Election Commission of Pakistan and relevant governmental agencies to realise electronic voting.

- **Joint Public-Private Ventures**

The costs of e-voting in Pakistan can decrease through partnerships between public and private entities and using PTCL infrastructure. Such methods improve affordability and operational efficiency, together with security features that make digital voting easier to access and maintain.

- **Discussions with Appropriate Societal Groups**

For Pakistan to establish inclusive e-voting, it must actively involve relevant social groups (RSGs). A specialised team must continuously discuss this with RSGs to develop confidence while collecting suggestions and creating an operational representative system suitable for multiple community requirements.

- **Public education and awareness campaigns**

The lack of digital knowledge prevents e-voting from succeeding in Pakistan. The implementation of effective e-voting depends on the support provided by government and private organisations. Pakistan can learn from India, the

Philippines, and Estonia about their success in creating user-friendly systems along with digital literacy, which will help Pakistan find successful methods to adopt e-voting.

Data Availability Statement

Request data verifying this study's conclusions from the corresponding writer. Data aren't published since it could threaten research participant privacy/consent.

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