TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Aghahuseyn Aghabayli 214204IVGM

Internet voting in Azerbaijan: Possible implementation, challenges, and potential

Master's thesis

Supervisor: Richard Michael Dreyling

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

Aghahuseyn Aghabayli 214204IVGM

Interneti-hääletus Aserbaidžaanis: võimalik rakendamine, väljakutsed ja potentsiaal

Magistritöö

Juhendaja: Richard Michael Dreyling

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: Aghahuseyn Aghabayli

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Abstract

Nowadays, digitalization rapidly changes every aspect of our lives. Electronic governments have become increasingly important, replacing old-school bureaucratic methods with modern, efficient digital systems. Estonia is at the forefront of this digital revolution, implementing new technological innovations and expertise to create a well-structured e-government system that reduces costs and helps people complete tasks quickly and easily.

Estonia has made significant strides in internet voting, a system allowing citizens to vote electronically. This research thesis explores the current state of internet voting worldwide, focusing on the Estonian experience. The theory examines the feasibility of implementing internet voting in Azerbaijan, a country that has yet to adopt this technology.

By researching the challenges and advantages of internet voting and the reasons preventing Azerbaijan from implementing it, the thesis aims to answer whether internet voting can be successfully implemented in Azerbaijan. This research will be valuable to public servants, teachers, and other researchers seeking to expand their knowledge.

The thesis follows a qualitative research methodology to answer these questions, conducting surveys and interviews to gather data and insights. The findings will be combined with theoretical research to provide a comprehensive overview of internet voting and its potential application in Azerbaijan. By providing an in-depth analysis of internet voting and its benefits and challenges, this thesis will contribute to the growing body of research on digital governance and will be a valuable resource for anyone interested in this topic.

This thesis is written in English and is 58 pages long, including an introduction and five chapters.

List of abbreviations and terms

e-government	Electronic government
I-voting	Internet voting

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1 Introduction

Technology is changing how we live, work, and communicate. Governments worldwide are taking notice and realising that they can use technology to make things better for everyone. E-Government is a way for governments to use technology to provide public services more efficiently and make it easier for people to follow the rules and regulations. E-Government can save money for individuals, businesses, and the government by reducing paperwork and streamlining processes. Unsurprisingly, leaders worldwide want to adopt e-Government because it can make things easier, faster, and more cost-effective for everyone. [Shabani, I. (2022)] Modern technology may change voting, a crucial part of democracy. The conventional method of requiring voters to go in person to a polling station seems outdated, especially since more transactions are happening online. [Piret Ehin, (2022)] Estonia became the first nation to implement internet voting nationally during binding elections in 2005. Although internet voting is just one of many voting methods in Estonia, the number of voters using this method has increased dramatically. Factors contributing to its success include the country's relatively small size and positive experiences with earlier e-government services. The secure online authentication token, the ID card, is also critical in enabling remote voting in an unmonitored setting. [Vinkel, P. (2012)] Internet voting was initially introduced in the United States in 2000. Since then, 14 countries have adopted internet voting. Four countries actively use internet voting, including Canada, France, Estonia, and Switzerland. Estonia stands out as the only country that offers internet voting nationwide. [Anooja A. (2016)]

Advocates of internet voting provide several reasons to support this form of voting. They argue that internet voting is more convenient than traditional paper-based voting since it allows voters to select their preferred candidate without leaving their homes. This offers various benefits. Firstly, obstacles like harsh weather conditions, long queues, and confusion regarding the location of polling stations will not prevent people from casting their votes. Secondly, with internet voting, waiting in long queues is unnecessary. Citizens can vote from libraries or workplaces where they can access the internet. [Alvarez, R. M., & Hall, T. E. (2003)] Given the pandemic's current situation

and unpredictability, this aspect of internet voting is particularly appealing. Internet voting offers a cost-effective way of voting, which can benefit many people who live far away from their homes, such as soldiers and sailors. While some countries, like the US, offer absentee ballots, an absentee ballot is more complicated than internet voting. Research indicates that many people face obstacles when using absentee ballots in the US. According to R. Alvarez's book "Point, Click, and Vote," absentee ballots and internet voting help people serve their country. However, absentee ballots have limitations because it is difficult to coordinate their procurement and ensure their timely return for counting. During the last presidential election, military personnel experienced numerous voting problems. Internet voting could have allowed them to vote from anywhere worldwide with confidence that their vote would be received and counted.[Alvarez, R. M., & Hall, T. E. (2003), page 5] Internet voting can also benefit individuals with disabilities and health conditions. The traditional method of visiting polling stations can pose challenges for these groups. Internet voting can ease their burden by providing a more accessible option. For instance, visually impaired individuals can use Braille configurations on their computers to cast their votes independently. Overall, internet voting offers faster, more accurate, and more efficient vote counting and greater accessibility for individuals facing physical or cognitive barriers. [Micha Germanna, Uwe Serdültb. (2017)] Internet voting will also increase the quality of the vote. For example, in Azerbaijan, some people must consider the candidate and their election platform rather than voting recklessly. With the implementation of the internet voting system, before casting their vote, potential voters will research the internet and obtain more information about the candidate. It will increase the quality of the vote. [Alvarez, R. M., & Hall, T. E. (2003)] With internet voting, citizens can avoid common mistakes such as casting more votes than allowed. Finally, and most importantly, internet voting can change the nature of political campaigns. As we know from Estonian experience, citizens can change their vote many times till the last minute of election day. [*Internet voting in Estonia | Elections in Estonia*.] On the other hand, we have experienced that candidates make their previous attacks (speeches) in the final hours when most people have already voted. With internet voting, citizens can reconsider their vote after seeing this kind of speech.

There are a lot of challenges to internet voting besides its benefits. First, internet voting takes place in an uncontrolled environment. It is difficult to know whether voters freely cast their votes or not. As you know, there can be a lot of pressure from opposing parties in the voting process. But as we know from Estonian experience, there is a solution to this problem. With internet voting, people can vote many times, and there is always an opportunity to change one's mind at the last moment. The second problem with internet voting is security concerns. Recently, there have been many cyber-attacks on essential systems such as power grids, transportation networks, and companies by groups called Advanced Persistent Threats (APT) or other cybercriminal organisations. Government entities sometimes carried out these attacks, such as Russia's attack on Estonia in 2007. There have also been attacks that have targeted physical infrastructure, like those against government facilities. The opponents of internet voting argue that such threat groups can hack individual machines or entire systems to such an extent that it can change the whole election process. Also, malware on the voter's device can affect voting. Opponents also say verifying whether the vote has arrived at the intended address may be difficult. But as we know from the example of Estonia, there is a verification system which enables you to verify your vote and make sure if the vote has been recorded or not. Additionally, we know that in Estonia, ballots are counted with a system with no internet connection. This is also an excellent approach to strengthen the system and prevent attacks.

The digital divide is a problem for internet voting as well. When we say "digital divide," we mean the gap among sociodemographic groups when accessing the Internet. Some people have better internet access than others, which can cause trouble among those who do not have desirable access to the internet. The most crucial criticism of internet voting is that it can affect civic life. When we say civic life, it refers to the fact that, for example, in paper-based elections, people go to polling stations and participate in one of the essential processes of the country. With internet voting, they can lose and forget this responsibility. This also reduces civic involvement and public discussions. [Alexander Trechsel, Vasyl Kucherenko and Frederico Silva (2016)] It is also believed internet voting may increase social seclusion within society.

From a legal perspective, the legal analysis should focus on Internet voting's impact on the constitutional principles of electoral law, such as universality, equality, accessible voting, secrecy, and direct suffrage.

1.1 Outline of the thesis

The author of this thesis intends to explore the possibility of implementing internet voting in Azerbaijan, a country where internet voting is not yet available. This research study will rely on a literature review, surveys, and interviews to analyse and investigate the feasibility of internet voting in Azerbaijan.

One of the primary motivations for this study is the lack of information and case studies on internet voting in Azerbaijan. Therefore, this study aims to fill a literature gap by providing a detailed analysis of the potential challenges and advantages of implementing internet voting in Azerbaijan.

The thesis will be structured into several chapters. The first chapter will provide a general background and state-of-the-art review of internet voting, drawing on a literature review and exploring examples of countries adopting internet voting, such as Estonia.

The second chapter will focus on the research methodology used in this study, explaining the approach taken to analyse and investigate the feasibility of internet voting in Azerbaijan.

The third chapter will introduce the case study of Azerbaijan and its current electoral system, providing a detailed overview of the existing voting infrastructure and procedures.

In the fourth chapter, the outcomes of surveys and interviews will be presented and analysed, providing insights into the perceptions and attitudes of the Azerbaijani people towards internet voting.

The last chapter of the thesis will present the findings and recommendations of the study, drawing conclusions about the feasibility of internet voting in Azerbaijan and suggesting potential solutions and strategies for implementing it in the future.

1.2 Motivation for the research

The author of this thesis is interested in exploring the potential benefits and challenges of implementing internet voting in Azerbaijan. This country still needs to adopt this form of voting. The author recognises that internet voting can offer several advantages, such as increasing voter turnout, enhancing accessibility, and reducing costs. However, the author is also aware that potential challenges must be addressed before implementing internet voting in Azerbaijan, such as ensuring the security and integrity of the voting process, preventing voter fraud, and addressing concerns about the privacy and anonymity of the vote. Through this thesis, the author aims to investigate these issues in-depth and to offer insights and recommendations for policymakers and election administrators in Azerbaijan who may be considering the implementation of internet voting.

1.3 Research questions

In this thesis, the author aims to provide a comprehensive understanding of the current state of internet voting worldwide, focusing on Estonia as a case study. The research is primarily motivated by the desire to explore the feasibility of implementing internet voting in Azerbaijan and to address several research questions.

Meta question 1.

How Is it possible to implement internet voting in Azerbaijan in the future?

- Research question 1. What level of demand is there to implement internet voting in Azerbaijan? The research question is intended to provide an answer according to the survey.
- Research question 2. What do the public servants and ordinary people think about internet voting in Azerbaijan? The research question is intended to provide an answer according to interviews/surveys with public servants in Azerbaijan.

Meta question 2.

How would Azerbaijan implement I-voting?

- Research question 1. What will be the challenges and advantages of internet voting in Azerbaijan?

- Research question 2. What can be learned from the Estonian experience in this regard? This research question is intended to find answers through literature reviews and give recommendations.

The author aims to comprehensively analyse the potential for internet voting in Azerbaijan, considering global trends, stakeholder perspectives, and the Estonian experience. The research questions are intended to guide the investigation and provide valuable insights for policymakers and other stakeholders interested in exploring the possibility of implementing internet voting in Azerbaijan.

2 General background and State of the Art in the field of I-voting

To gain a comprehensive understanding of this topic, the first section of this chapter explores the literature study of Internet voting using peer-reviewed publications, Google Scholar, university libraries and news portals.

The second section will display the world's existing internet voting systems and their applications. These abilities will help us comprehend the subject when transitioning from this chapter to the case study.

2.1 Literature review

Short history of internet voting:

The 2000 U.S. Presidential Election: The Arizona Democratic Primary marked the first online voting in a binding public election in the United States (Solop, 2001). The Estonian Experience: Estonia pioneered internet voting with the nation's first online parliamentary election in 2005 (Madise & Martens, 2006). By 2019, approximately 44% of votes were cast online in the Estonian parliamentary elections (Vassil et al., 2020). The Swiss Experiment: Switzerland has conducted various trials of internet voting since 2003 at both the cantonal and federal levels (Gerlach & Gasser, 2009). Despite the many advantages of internet voting (I-voting), such as convenience, accessibility, speed, and cost reduction, most countries still rely on traditional paper-based voting. This is despite recent trials of I-voting systems in some countries that have been suspended or abandoned. [Ehin, P., Solvak, M., Willemson, J., & Vinkel, P. (2022)]. In Norway, there were trials of an I-voting system during national and municipal elections in 2011 and 2013. However, the experiment was abandoned due to concerns about the privacy of votes and potential harm to democratic procedures. The trials did not increase voter turnout, and political unrest existed about the initiative to modernise voting processes. As a result, the Office of Modernization announced the termination of the tests after discussions in the country's parliament. [BBC. (2014, June 27).] Internet voting systems have faced challenges in some areas, such as the Ailand Islands, where the implementation of an internet voting system was cancelled due to system failure. [Duenas-Cid, D., Krivonosova, I., Serrano, R., Freire, M., & Krimmer, R. (2020b)]. The Swiss government suggested introducing an electronic voting system, but some computer experts were sceptical. A lively discussion ensued among politicians, government officials, and computer scientists, resulting in a well-informed decision. The conclusion was that the risk of election fraud was too significant, which threatened Switzerland's direct democracy, which is the cornerstone of its democratic system. As a result, the proposal to introduce electronic voting was rejected. [Kuenzi, R. (2020, June 23)] Due to concerns about possible cyberattacks, the French government decided not to allow overseas nationals to vote online in the June parliamentary elections. This decision was made in the context of growing concerns about foreign interference in Western elections, especially after accusations that Russia hacked the U.S. presidential election, which Moscow has denied. The National Cybersecurity Agency considered

cyberattacks a high-risk factor. The government decided it was better not to take any risks that might endanger the legislative vote for French people living abroad. [Thomson Reuters. (2017, March 6)] Besides all these, Estonia has been exceptional. One important lesson is that context plays a significant role in the success of remote voting systems, as Estonia is a small and highly centralised nation with a comprehensive voter registry and a sample ballot. Another lesson is that an adequate legal and regulatory framework is necessary, as seen in Estonia's enabling legislation for national identification and digital signatures and a careful political process before deployment. Additionally, voter authentication is crucial for secure Internet voting, and Estonia's use of an intense form of online voter authentication through its national identification card has been successful. The article suggests that governments may develop and implement these forms of solid digital identification for various other purposes, such as paying fines, fees, and taxes. The article concludes that while the United States may be a leader in the online world, the lack of a robust professional election administration culture, cohesive election laws that facilitate online transactions, and the complexity of American elections, all limit the ability of Internet voting to gain traction. [R. Michael Alvarez, Thad E. Hall and Alexander H. Trechsel**,** 2009]

Additionally, Since the early 2000s, several countries have investigated and tested internet voting systems due to their potential to increase participation and improve the efficiency of elections. [Ehin, P., Solvak, M., Willemson, J., & Vinkel, P. (2022)] Switzerland has conducted over 300 e-voting trials in 15 cantons, but it has not been available since July 2019. The Federal Council tasked the Federal Chancellery to collaborate with the cantons to redesign the e-voting trial phase with four objectives: further development of the systems, effective control and oversight, increasing transparency and trust, and closer cooperation with the academic community. In 2020, the Federal Chancellery and cantons produced a final report on redesigning and relaunching e-voting trials. The legislation on e-voting has been revised, and three cantons have been granted essential licenses for resuming tests with online voting in federal votes until 18 May 2025. Swiss Post's e-voting system with complete verifiability will be used for the first time, and its operation has been further developed and examined. The Federal Chancellery has granted its authorisation to the cantons for the popular vote of 18 June 2023, and it will monitor the implementation of measures in future authorisation procedures.[Swiss Federal Chancellery. "E-Voting in Switzerland:

Online Voting System."] Norway conducted trials of internet voting on a large scale during the 2011 local elections and 2013 parliamentary elections. The central government administered these elections using software from an international e-voting vendor. In 2016, several municipalities conducted local referendums using internet voting, and in May 2018, Finnmark fylke (county) held a referendum using internet voting. In all cases, traditional paper voting was also available for accessibility reasons and to prevent coercion. The trials did not aim to increase voter turnout; no evidence suggests they did. However, later local referendums showed a significant increase in voter turnout when using internet voting, consistent with experiences from other countries.[Christian Bull, Henrik Nore] The Lithuanian government has supported a proposal to introduce online voting but suggests that it should be trialled initially with expatriate voters. The Cabinet has approved the amendment enabling voters to vote online in the upcoming general elections later this year.[18] Democracy Live's OmniBallot platform provides a web-based solution for blank ballot delivery, marking, and online voting. In early 2020, Delaware, West Virginia, and New Jersey announced they would allow sure voters to vote online using OmniBallot. However, despite the well-known risks associated with internet voting, the system has never been subjected to a public, independent security review. [Specter, M., & Halderman, J. A. (1970, January 1)]

The advantages of internet voting:

Much scholarly research points to various advantages. Here are only a few of their benefits: Improved voter turnout: According to Alvarez, R. M., & Hall, T. E. (2008), internet voting may boost voter turnout by giving citizens a more practical and accessible choice, especially for those who are physically impaired or reside overseas. Cost savings: Online voting can reduce the cost of holding elections by eliminating the need for physical infrastructure like polling places and printed ballots (Solop, F. I. (2001). Faster results: Online voting enables speedier vote tally and result reporting, potentially increasing election process efficiency (Trechsel, A. H., & Mendez, F. (2005). Younger voters are more inclined to interact with technology, and internet voting may encourage them to vote more frequently (Stein, R. M., & Vonnahme, G. (2008). Benefits for the environment: Online voting can help preserve the environment

by reducing the amount of paper used and trash produced by traditional paper ballots (Gibson, R. K., Lusoli, & Ward, S. (2005). It is important to remember that online voting also brings up issues with security, privacy, and the potential for outside intervention. The discussion around the use of online voting systems has focused heavily on these difficulties.

The disadvantages of internet voting:

Despite the apparent benefits of online voting, there are severe drawbacks and issues, as shown by several academic studies: Security risks: Online voting systems are susceptible to hacking, cyberattacks, and other types of election interference, which can jeopardize the results (Wolchok, S., Wustrow, E., Halderman, J. A., & Prasad, K. (2012). Voter privacy and intimidation: While voting online, the ballot's confidentiality may be jeopardized, opening the door to vote buying, coercion, or intimidation (Jefferson, D., Rubin, A. D., Simons, B., & Wagner, D.) (2004).
Digital divide: Online voting may increase already-existing disparities in people's knowledge of and access to technology, harming specific populations like the elderly or those with lower socioeconomic status (Alvarez, R. M., & Hall, T. E. (2008). Voter authentication: It can be challenging to confirm a voter's identity online, and internet voting carries a more significant risk of identity theft or voter impersonation than traditional voting techniques (Simons, B., & Jones, D. W. (2012).
Foreign meddling: As seen by the 2016 U.S. presidential election, which saw Russian hackers attack voting systems, internet voting raises the possibility of foreign meddling in elections (Jamieson, K. H. (2018). Public confidence in the political process may decline due to worries about the security and privacy of online voting, thus affecting the validity of election outcomes (Schneier, B. 2000).

In conclusion, while internet voting offers potential advantages, these disadvantages and concerns must be carefully considered and addressed before widespread implementation can be considered.

The legal framework of the Estonian i-voting system:

Estonia is a democratic country with a population of 1.3 million and a competitive multi-party political system. The country ranks high in political rights and civil liberties. Elections for the national parliament and local government councils are held every four years, and European Parliament elections have been held every five years since joining the EU in 2004. The electoral system is based on open-list proportional representation, and voters can register to vote without any action. Voters can cast their ballots using conventional paper, early, or internet voting, which has been available since 2005. Internet voting is an optional alternative to paper voting, open during the designated early voting period. Voters can vote from any internet-connected computer worldwide, using an Estonian ID card or mobile ID to authenticate themselves, choose their preferred candidates, and encrypt and confirm their vote with a digital signature. The voting process takes less than two minutes on average. Voters can change their electronic votes unlimited times during the early voting period, and voting at the polling station during the early voting period invalidates the electronic vote. From 2021 onwards, i-voters can also cast a paper ballot on Election Day. [Ehin, P., Solvak, M., Willemson, J., & Vinkel, P. (2022)]

The general principles and procedures of electronic voting in Estonia. It specifies that the Electronic Voting Committee shall hold electronic voting, and the National Electoral Committee will establish the technical requirements for the electronic voting system. Voters can vote themself and may change their vote cast by electronic means. Before the start of electronic voting, the Electronic Voting Committee shall create the encryption key for electronic votes and the vote-opening key. The voter will identify themselves by a certificate that enables digital identification, issued based on the Identity Documents Act. After the voice is cast, a notice will be displayed to the voter indicating their vote has been considered. A voter has the right to change their vote cast by electronic means by voting again or by voting with a ballot paper. The National Electoral Committee will establish the procedure for verifying electronic votes. After the electronic voting is closed, the Electronic Voting Committee will prepare a list of persons who voted using electronic means and forward it to the county electoral committees, who will then deliver it to the voting district committees. If a voter has voted electronically and with a ballot paper, the voter's ballot paper will be considered. However, suppose a voter has voted several times

outside the voting district of his or her residence using electronic means. In that case, all envelopes with the voter's ballot papers and the vote cast using electronic means shall not be considered.[Andmevara, A. S.]

Estonia is a pioneer in internet voting and has successfully conducted multiple elections using its i-voting system since 2005. The legal framework that governs the Estonian internet voting system is established by various laws and regulations, including

1. Constitution of the Republic of Estonia: The Estonian Constitution guarantees the right to vote and establishes the principles of democratic governance.
2. Local Government Council Election Act: This law, amended in 2002 to include provisions for electronic voting, sets the regulations and procedures for local government council elections. The Act outlines the principles of internet voting, the preparation and conduct of i-voting, and the verification and counting of electronic votes.
3. Riigikogu Election Act: This law sets the regulations and procedures for the election of the Parliament of Estonia (Riigikogu). It includes provisions for electronic voting, similar to those in the Local Government Council Election Act.
4. European Parliament Election Act: This law regulates the procedures for electing members of the European Parliament from Estonia. It also contains provisions for internet voting, consistent with those in the Local Government Council Election Act and the Riigikogu Election Act.
5. Referendum Act: This law governs the conduct of national referendums in Estonia. While the current version does not include provisions for internet voting, future amendments may extend i-voting to referendums as well.
6. Electronic Voting Committee: The National Electoral Committee establishes the Electronic Voting Committee, which organizes and manages the technical aspects of internet voting. The committee ensures the proper functioning of the i-voting system, the security of voting data, and the verification and counting of electronic votes.
7. Personal Data Protection Act: This law regulates the processing of personal data, including voter information, and ensures personal data privacy and security in internet voting.

The legal framework of Estonian internet voting provides a solid foundation for a secure, transparent, and verifiable i-voting system. It establishes clear procedures and guidelines for organizing and conducting elections using electronic means, protecting voter privacy, and ensuring the integrity and accuracy of the voting process.

Technical overview of the Estonian internet voting system:

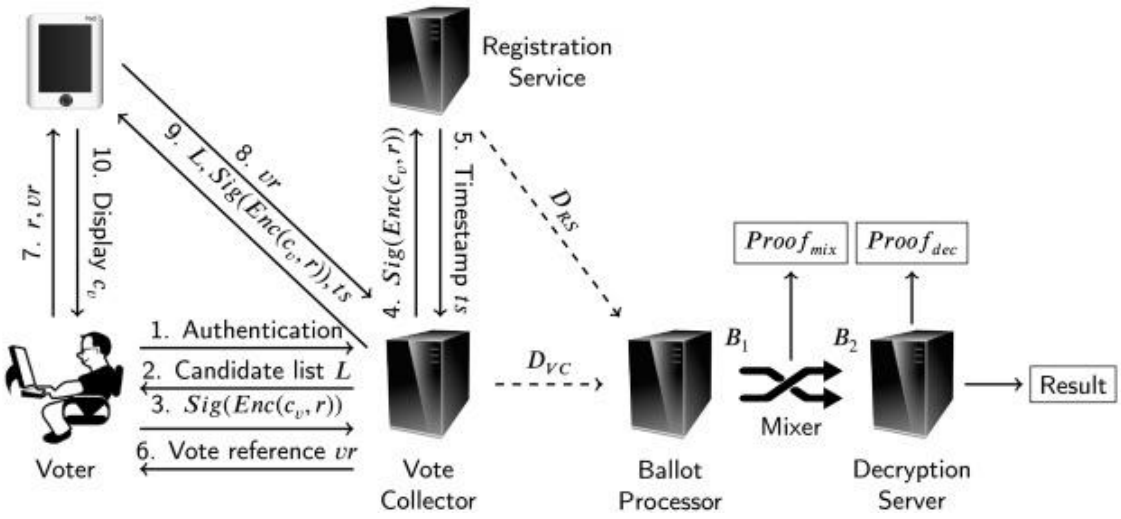


Figure 1

The voting process begins with the voter authenticating themselves on the PC-based voting application using an electronic identity mechanism. The server responds by sending the list of candidates for the voter's district. The voter then selects their preferred candidate and encrypts their vote using the Decryption Server's public key. The encrypted voice is then signed with the voter's electronic ID and returned to the Vote Collector server. To prevent the loss of votes, the protocol requires the vote to be committed to a separate Registration Service, which produces a timestamp certifying that the ballot has been saved. The voter can then verify their voice through an independent mobile device using a QR code provided by the Vote Collector server. The mobile device receives the list of candidates, the encrypted ballot, and the timestamp from the server. The mobile device cannot decrypt the vote directly. Still, it can verify the timestamp and signature and display the candidate on its screen for the voter to compare with their original intent. After the voting period, the ballots are prepared for tallying and transferred to an offline Ballot Processor unit. The resulting ballot list is sent through a Mixer component,

producing an output ballot list and cryptographic proof of correct mixing. The vote cryptograms are decrypted using the Decryption Server's private key to make the result and cryptographic verification of correct decryption. [Ehin, P., Solvak, M., Willemson, J., & Vinkel, P. (2022)]

The Estonian Internet voting (i-voting) system is a prominent example of a secure and efficient electronic voting system. The system has been used since 2005 for various parliamentary, local government, and European Parliament elections. Here's a technical overview of the Estonian i-voting system:

1. Voter authentication: The Estonian i-voting system relies on a national ID card, Mobile-ID, or Smart ID for voter authentication. These digital identification methods use secure public critical infrastructure (PKI) to verify the voter's identity. Estonian citizens are provided with a unique personal identification code (PIC) used during the authentication process.
2. Voting process: Once authenticated, voters can access a list of candidates or parties and vote electronically. The system allows voters to change their vote multiple times during the voting period. Only the last vote is counted, and any previous votes are invalidated.
3. Vote encryption and signing: The voter's choice is encrypted using a public key provided by the voting server. The voter digitally signs the encrypted vote using their private key, ensuring the vote's integrity and authenticity.
4. Vote submission and storage: The encrypted and signed vote is submitted to the voting server. The server verifies the digital signature and checks the voter's eligibility before storing the vote in a secure database. A "vote confirmation" is then displayed to the voter, ensuring their vote has been successfully cast and recorded.
5. Decryption and tallying: The encrypted votes are decrypted and counted after the voting period has ended. The decryption process uses a combination of secret keys held by multiple election officials, ensuring no single person can decrypt the votes. The decryption and tallying process is performed in a secure and isolated environment, protected from unauthorized access.
6. Verification and auditing: The Estonian i-voting system features end-to-end verifiability, allowing voters to verify that their vote has been cast and recorded

correctly without revealing the actual vote. Independent observers can also audit the voting process by examining the encrypted votes, digital signatures, and decryption proofs published on a public bulletin board.

7. Security measures: The i-voting system employs several security measures to protect against potential threats, such as secure communication channels, encrypted data storage, regular security audits, and monitoring for suspicious activity. The system also relies on multiple servers with redundant and geographically diverse locations to ensure high availability and fault tolerance.

The Estonian internet voting system is designed to provide voters with a secure, transparent, and user-friendly experience. It combines strong voter authentication, encryption, and digital signatures with robust security measures to ensure the voting process's integrity, privacy, and verifiability. [Introduction to i-voting | Elections in Estonia (valimised.ee)]

Tam and UTAUT

The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) can be applied to understand user acceptance and adoption of internet voting systems.

TAM can help understand the factors influencing voters' acceptance and use of internet voting systems. Perceived usefulness and ease of use determine a technology's acceptance. In internet voting, perceived usefulness refers to how well the technology meets the voters' needs, such as accessibility and convenience. Perceived ease of use refers to how straightforward the internet voting system is for voters. Studies have shown that internet voting systems' perceived usefulness and ease of use are significant determinants of voters' intention to use such systems (Alvarez et al., 2019).

UTAUT, on the other hand, takes a more comprehensive approach by considering other factors, such as social influence and facilitating conditions, that may impact the adoption of internet voting systems. In the context of internet voting, social influence refers to the extent to which other people, such as family members, peers, or government officials,

encourage or discourage internet voting systems. Facilitating conditions, such as access to technology, technical support, and trust in the system, are also essential factors in adopting internet voting systems.

Studies that have applied UTAUT to internet voting have shown that performance expectancy, effort expectancy, social influence, and facilitating conditions are significant predictors of voters' behavioural intention to use internet voting (Chen et al., 2018; Teixeira & Ferreira, 2019).

Overall, both TAM and UTAUT can provide insights into the factors influencing voters' acceptance and adoption of internet voting systems. Understanding these factors is crucial in designing and implementing internet voting systems that are accessible, secure, and trustworthy for voters.

2.2 Internet voting overview

This passage describes the use of internet voting in countries around the world. According to Figure 2, 41% of countries using e-voting have adopted internet voting systems, with 14 out of 34 countries using this method. The passage then outlines the patterns of internet voting use in various countries. Internet voting is used within the country for all voters in Estonia and the United Arab Emirates. In Australia, Canada, Russia, and South Korea, it is limited to specific groups of voters or regions. Internet voting is available mainly for out-of-country voting in Armenia, Ecuador, France, Mexico, New Zealand, Oman, Pakistan, and Panama and for military voting in Armenia. The passage concludes that internet voting is mainly used for out-of-country voting and is limited to specific groups of voters when used within the country. It is also noted that email voting from abroad is not considered internet voting in this context.[Use of E-Voting Around the World]

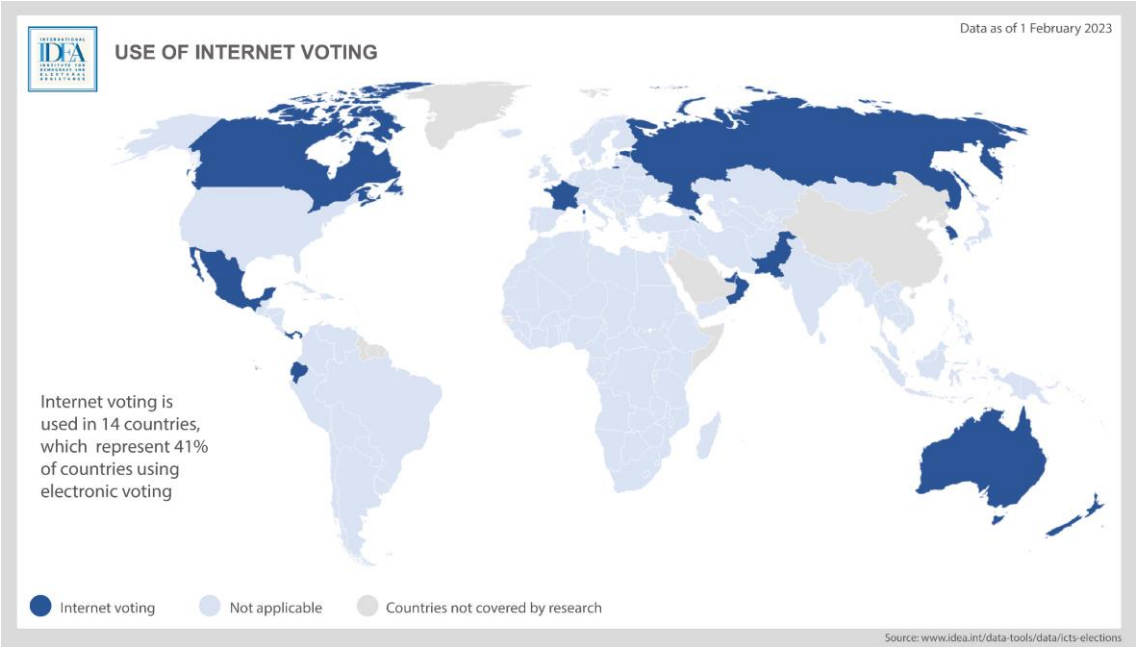


Figure 2.

The Estonian Conservative People's Party (EKRE), one of the main political parties in Estonia, has appealed to the Supreme Court to invalidate the e-vote results of the Riigikogu election because the regulation of e-voting is unconstitutional. The lawyer, who represents EKRE, stated that the statutory law governing e-voting and vote-counting is entirely inadequate and, therefore, unconstitutional. He argued that the Riigikogu gives the order and conditions for conducting e-voting to be established by the State Electoral Committee (VVK), which is unconstitutional and goes against the principle of the separation of powers. The lawyer also highlighted anomalies in how the current elections have been conducted, such as the rise in e-votes after the e-voting polls closed and the need for proper regulation for e-voting compared to paper ballot voting. The Supreme Court has not ruled in favour of previous attempts to challenge e-voting. However, EKRE believes that the attention drawn to the issues four years ago and the current anomalies could make a difference in this appeal. [ERR, I. K. |. (2023, March 9)]

Estonia has made significant efforts to develop an efficient i-voting system, widely accepted by the electorate, as shown by the i-voter turnout in the Riigikogu Elections of 2011. The article describes the Estonian i-voting scheme and discusses its compliance with electoral principles. However, the analysis of the 2011 elections revealed weaknesses in the i-voting system, which were exploited in real-life attacks, highlighting the need for a more secure i-voting protocol. This may require refining i-voting legislation to meet new security requirements and reduce the trust needed in voters' computers. Achieving secure i-voting requires a comprehensive approach that considers the system as a whole, involving interdisciplinary and widely-accepted political decision-making. It is also essential to educate the general public about the system and the available options to reduce the risk of election result manipulation. [Heiberg, S., Laud, P., & Willemson, J. (1970, January 1)]

The study defines a *habit* as repetitive behaviour independent of the resources and supporting attitudes of the behaviour. The evidence shows that e-voting behaviour in Estonia is mainly habitual, meaning that people continue to use e-voting simply because they have done so in the past. This finding suggests that while e-voting may not address the underlying reasons for low voter turnout, it could help stabilise turnout by making it easier for those who are already likely to participate. Inducing repetitive behaviour and making it more habitual, e-voting could increase the resilience of voter turnout to short-term political disaffection. [*Could internet voting halt declining electoral turnout?]*

The use of e-voting has become widespread in Estonia, but it was initially only used by a specific group of well-resourced and tech-savvy voters. The study found that e-voting has become more accessible to a broad population, including those with fewer resources and less computer literacy. This diffusion of e-voting took place gradually, and it was only in the fourth election that it became more widely used by different groups. The study concluded that technology could bridge societal divisions and ease political participation, but policymakers should not expect immediate results. It takes time for technology to diffuse, and different subgroups of the electorate adopt and use new technologies at different rates. The study also found that e-voting is not exclusive to the privileged few but rather an inclusive participation form for a broad and heterogeneous group of voters. [Kristjan Vassil, 2016]

The idea of a bottleneck is often used to describe a process limited by one element while others are not fully utilised. In this case, the authors use this concept to explain why e-voting has not increased voter turnout as expected. They argue that politically engaged citizens mainly use e-voting, but its impact is highest among less engaged citizens. This suggests that e-voting has the potential to counteract inequality in political participation. However, the authors acknowledge that there is a bottleneck in the usage of e-voting that limits its overall impact. [*A bottleneck model of e-voting: Why technology fails to boost turnout*]

The authors also suggest that further research is needed to understand the implications of e-voting on non-voters and to explore the effects of electoral modernisation in different political and technological contexts. They note that the future role of e-voting is still being determined and will depend on factors such as its adoption rate and its ability to maintain its innovative character. The case of Estonia is used to illustrate these dynamics.[29]

E-Government in Azerbaijan:

Azerbaijan is located at the crossroads of Western Asia and Eastern Europe. Azerbaijan, officially called the Republic of Azerbaijan, is the largest country in the Caucasus region of Eurasia. It shares borders with Russia to the north, Georgia to the northwest, Armenia to the west, and Iran to the south, with the Caspian Sea to the east. The Exclave of Nakhichevan, surrounded by Armenia to the north and east, Iran to the south, and Turkey to the west, has a short border with Turkey to the northwest. [CIS Legislation]

Azerbaijan proclaimed its independence in October 1991 after seventy years of Soviet rule. [Heinrich, Andreas; Meissner, Hannes,2011]

The constitution states that elections for both presidential and parliamentary members must be conducted openly, directly, freely, equally, and confidentially. At one point, parliamentary and presidential polls required a 50% voter turnout threshold to be considered legitimate. [Andreas Heinrich, 2010]

The Principles of Participation in Elections and Referendum in Azerbaijan state that citizens must participate in elections and referenda based on general, equal and direct suffrage using secret and personal voting. Participation in such events must be free and voluntary, with no one able to pressure citizens to participate or impede them from expressing their will freely. Elections and referenda must be carried out freely and

publicly, and preparation and holding of these events, vote counting, and definition of results must be done similarly. Those participating in elections and referenda must respect the principles of freedom of the press and not interfere in the election campaigns of candidates or parties. They must also cooperate with election bodies and officials, respect authorised persons and observers, and not interfere with voters expressing their will freely. Violating certain principles will result in liabilities under the Criminal Code or the Code of Administrative Offences of the Republic of Azerbaijan. The Principles also outline universal suffrage, equal suffrage, direct ballot, and voting secrecy. [migration.gov.az]

Electronic government (e-government) has been a priority for Azerbaijan since the early 2000s. The government has implemented various initiatives to modernise its public services and improve citizen access to government information. Here is a brief history of e-government in Azerbaijan, with references to further reading:

1. 2003-2004: In 2003, the Azerbaijani government launched the "e-Azerbaijan" project, aimed at creating a national information and communication infrastructure. The project was funded by the World Bank and aimed to improve access to government services and promote e-commerce. In 2004, the government launched the first version of the e-government portal, providing citizens access to limited online services.
2. 2005-2008: In 2005, the government launched the "e-Government Development Concept", which aimed to create an integrated e-government system by 2010. The concept focused on improving government efficiency, transparency, and citizen participation. In 2008, the government established the E-Government Center, a dedicated agency responsible for implementing e-government initiatives.
3. 2009-2010: In 2009, the government launched the second version of the e-government portal, offering citizens access to a broader range of online services, such as tax payments and business registration. In 2010, the government introduced the "Mobile Government" project, enabling citizens to access government services through mobile phones.
4. 2011-present: In 2011, the government launched the third version of the e-government portal, which provides citizens access to more than 300 e-services. The portal has won several international awards for its innovative approach to e-

government, including the United Nations Public Service Award. The government has also launched several other e-government initiatives, such as the "Asan Imza" digital signature system and the "Asan Visa" e-visa system.

The Azerbaijani government has significantly developed its e-government capabilities over the past two decades. Its initiatives have been recognised internationally for their innovation and effectiveness in improving citizen access to government services.

The Azerbaijan e-Government portal is designed to give citizens easy access to government services and information. It was launched in 2011 as part of the government's efforts to increase transparency and efficiency in public services. The portal allows citizens to access a wide range of services, including online tax filing, registration of businesses, and access to government information.

One of the critical features of the Azerbaijan e-Government portal is its ability to provide citizens with a single point of access to all government services. This means that citizens can navigate multiple government websites to access different services. Instead, they can access all services through a single portal, making it easier and more convenient for them to interact with the government.

Another essential feature of the Azerbaijan e-Government portal is its emphasis on security and privacy. The portal uses advanced encryption technologies to protect citizens' personal information and prevent unauthorised access. This ensures citizens can confidently use the portal, knowing their data is safe and secure.

Besides providing access to government services, the Azerbaijan e-Government portal also offers citizens a range of resources and tools. These include online forums and discussion boards, where citizens can connect and discuss issues related to government services and policies. The portal also offers a range of educational resources, such as tutorials and guides, to help citizens understand how to use the portal and access government services.

Overall, the Azerbaijan e-Government portal is an important initiative that has helped to improve access to government services and information for citizens. It has been recognised as a model of best practices in e-government by international organisations such as the United Nations Development Programme (UNDP) and the World Bank.

"Asan Service" is a public service system developed and implemented by the State Agency for Public Service and Social Innovations under the President of the Republic of Azerbaijan. The system provides a unified platform for obtaining various public services in Azerbaijan. It aims to provide citizens easy and efficient access to public services, reduce bureaucracy, and improve state agencies' services.

The "Asan Service" centres offer a wide range of services, including registration of legal entities, issuance of various permits and certificates, passport services, and other services related to healthcare, education, and social security. The benefits are provided through an integrated system, which allows citizens to obtain services from different state agencies in a single location.

The "Asan Service" system has received international recognition and several awards for its innovation and effectiveness. In 2015, the system was awarded the United Nations Public Service Award for improving public service delivery. The World Economic Forum also recognised the system as a best practice in public-private cooperation. [41 - 49]

3 Research Methodology

3.1 Qualitative Research/Case Study

This thesis will follow a qualitative approach to explore and understand the challenges and potential of implementing internet voting in Azerbaijan. The study will adopt a case study design, focusing on Estonia's experience in implementing internet voting as a model for comparison.

The research will employ several data collection methods, including in-depth interviews with experts and stakeholders, focus group discussions with potential voters, and document analysis of relevant legislation and reports. Thematic analysis will be used to analyse the data collected from various sources.

To ensure ethical and rigorous research, the study will uphold confidentiality, informed consent, and anonymity in data collection. The researcher will also maintain reflexivity and positionality to acknowledge their bias and its impact on the research. Triangulation of data sources and perspectives, member checking, and peer debriefing will be employed to enhance the credibility and validity of the study.

The study will address two meta-questions about the possible implementation, challenges, and potential of internet voting in Azerbaijan. The study's findings will contribute to knowledge and provide insights for policy and practice in implementing internet voting in Azerbaijan. The study will also be a valuable resource for future researchers exploring internet voting in Azerbaijan. Finally, the study will culminate in a survey or interview with relevant stakeholders to gather feedback and insights on internet voting in Azerbaijan.

4 Introduction to the Case

Technology and digitalisation have become increasingly important in the modern world, with many countries implementing electronic governments to streamline processes and provide efficient services to their citizens. One of the latest technological innovations that governments are exploring is internet voting, which has the potential to revolutionise the way people participate in democracy.

In this thesis, we focus on Azerbaijan, a country located in the South Caucasus region, and its potential for implementing internet voting. Azerbaijan has a population of over 10 million, and its government has been exploring the possibility of implementing internet voting to improve democratic participation and enhance citizens' voting experience.

In contrast, Estonia, a small country in Northern Europe, has been successfully using internet voting since 2005 and is considered one of the leading countries in e-governance. Estonia's experience in implementing internet voting provides a helpful model for comparison and provides insights into the potential of internet voting in Azerbaijan.

This case study explores the challenges and potential of implementing internet voting in Azerbaijan. This research will investigate the reasons preventing Azerbaijan from implementing internet voting and identify the challenges and advantages of its potential application in a country like Azerbaijan. Additionally, this study will examine Estonia's experience in implementing internet voting and explore its relevance to Azerbaijan's context.

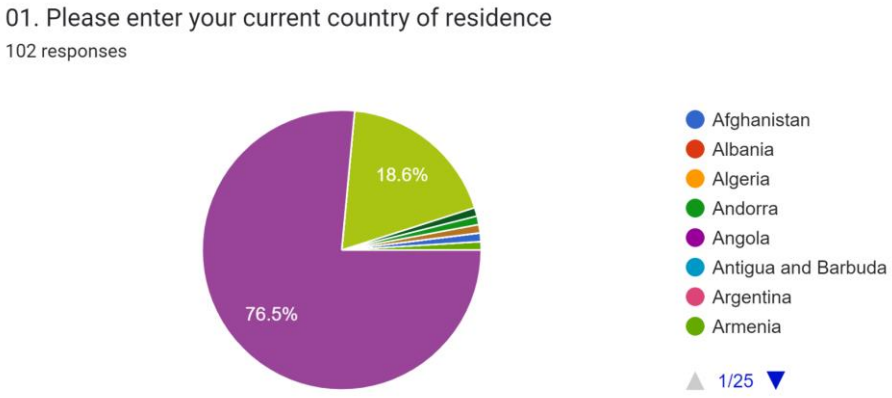
The study aims to provide valuable insights for policymakers, researchers, public servants, and other stakeholders interested in exploring the potential of internet voting in Azerbaijan. The research will contribute to knowledge by comprehensively analysing the current situation associated with internet voting and its potential implementation in Azerbaijan. Overall, this case study is expected to provide valuable insights into the

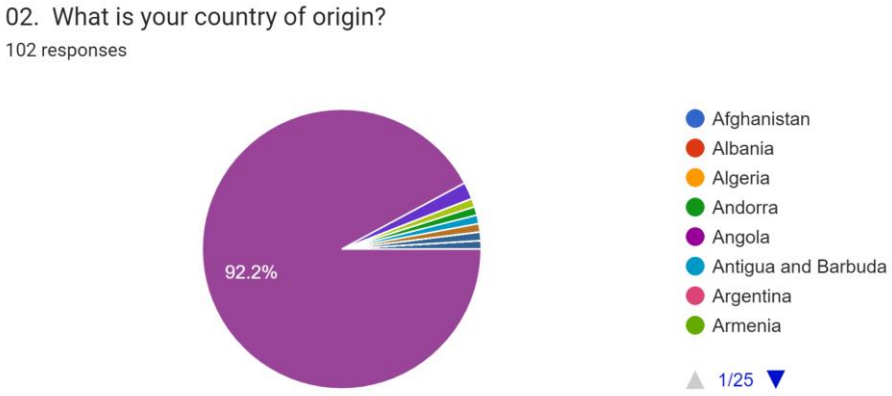
challenges and potential of internet voting in Azerbaijan and its relevance to other countries exploring the possibility of implementing it.

5 Results

5.1 Analyse and outcomes of Survey

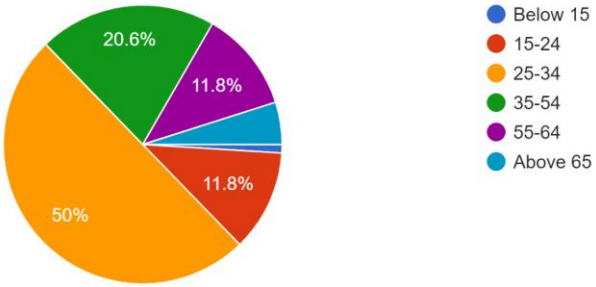
A survey about the potential implementation of an i-voting system in Azerbaijan was conducted from April 10, 2023, to May 6, 2023. The survey was disseminated on various social media platforms and received 102 responses from predominantly citizens of the Republic of Azerbaijan. The survey questions are presented in Appendix 2.





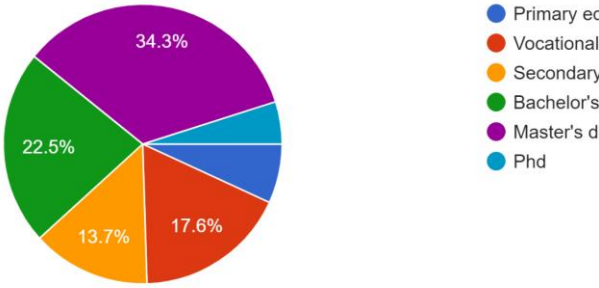
03. Please indicate your age category

102 responses



04. Please select your highest education level

102 responses

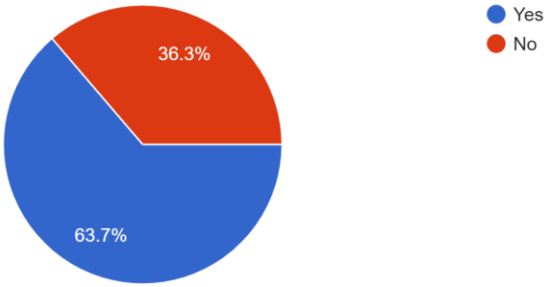


05. Which situation describes you best?

102 responses

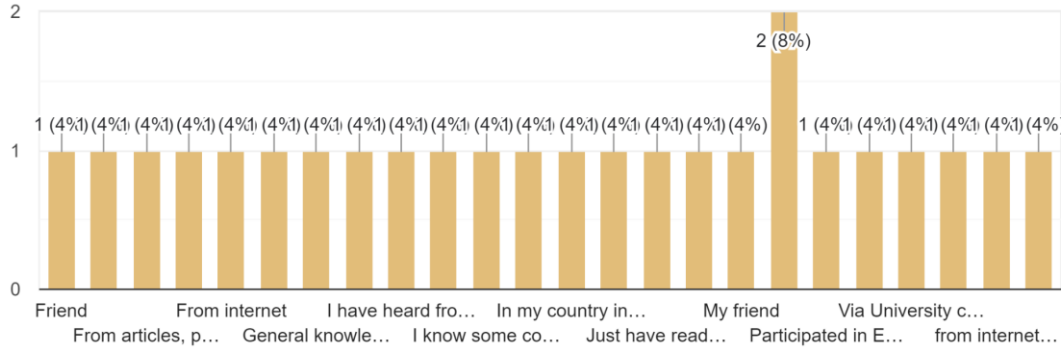
06. Are you familiar with the concept of Internet voting?

102 responses



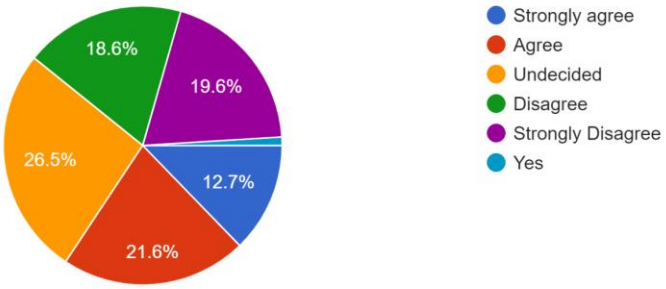
07. If yes, how do you know about it?

25 responses



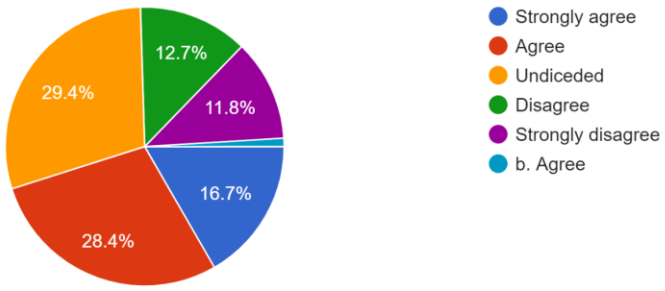
08. In your opinion, how likely can Internet voting be implemented in Azerbaijan?

102 responses



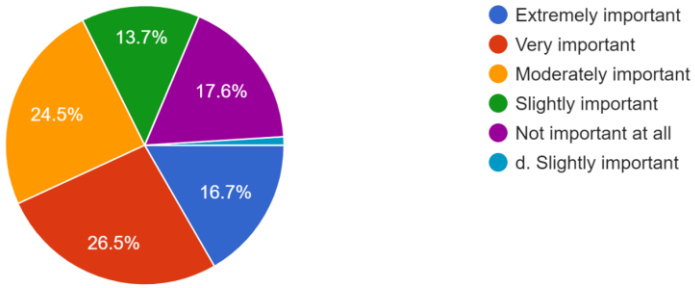
09. How likely do you believe implementing Internet voting in Azerbaijan would increase voter turnout?

102 responses

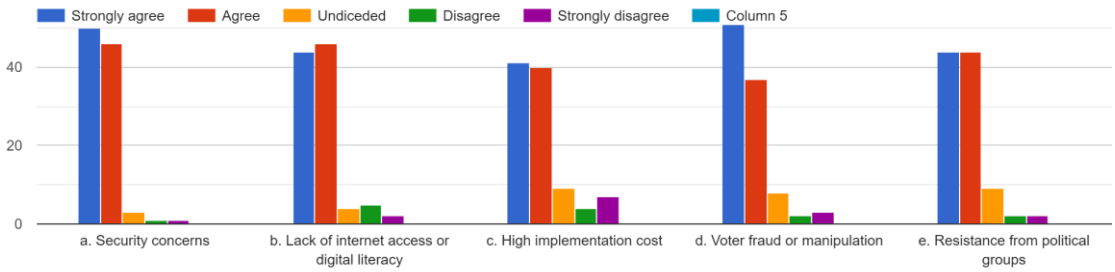


10. In your opinion how important is it for Azerbaijan to adopt Internet voting as an alternative voting method?

102 responses

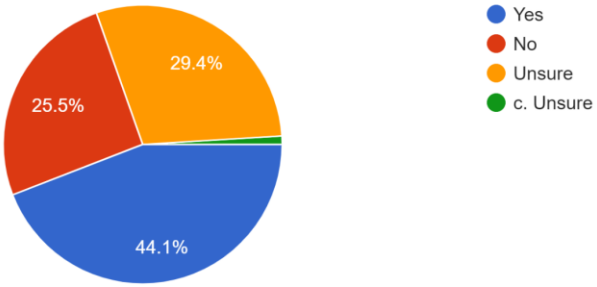


11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan?



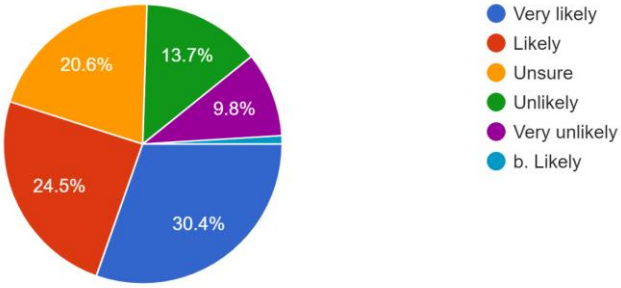
12. In your opinion Internet voting can be as secure as traditional, in-person voting?

102 responses



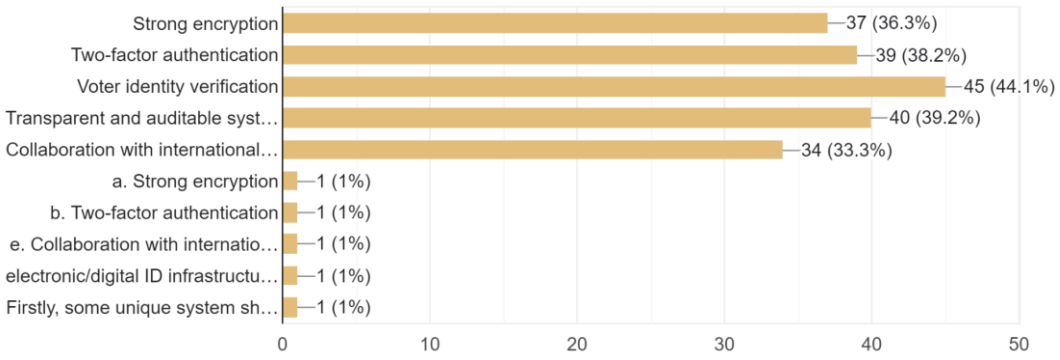
13. How likely are you to use Internet voting if it becomes available in Azerbaijan?

102 responses



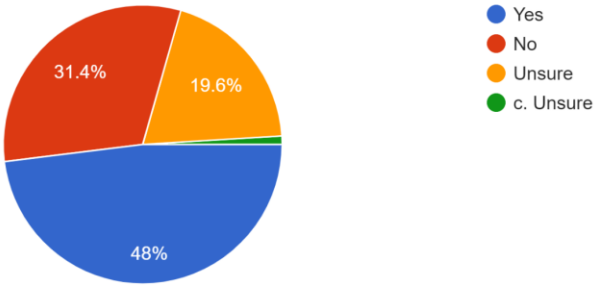
14. What measures should be taken to ensure the integrity and security of Internet voting in Azerbaijan? (Select all that apply)

102 responses



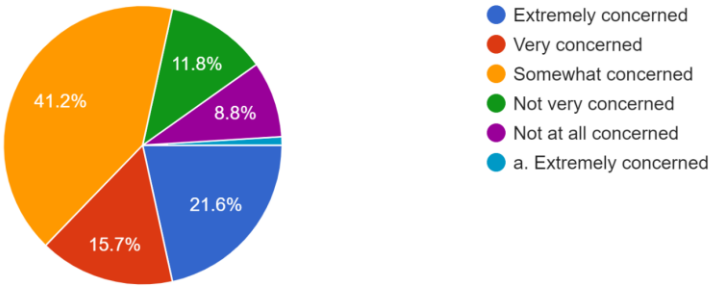
15. In your opinion Internet voting could potentially change the political landscape in Azerbaijan?

102 responses



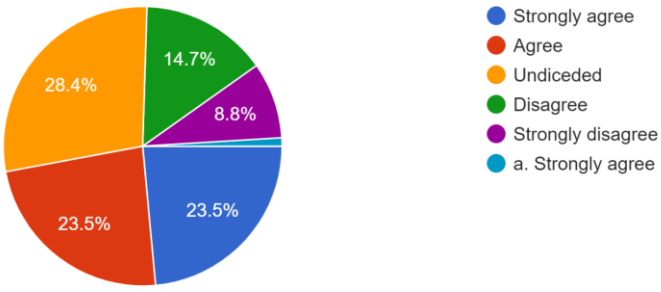
16. How concerned are you about the potential for foreign interference in Azerbaijan's Internet voting system?

102 responses



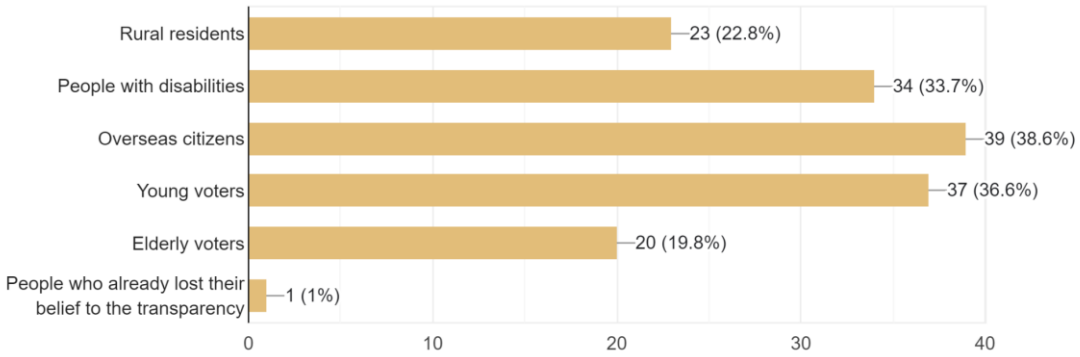
17. In your opinion Digital divide (equal access to the technology) would be a problem in implementing internet voting in Azerbaijan

102 responses



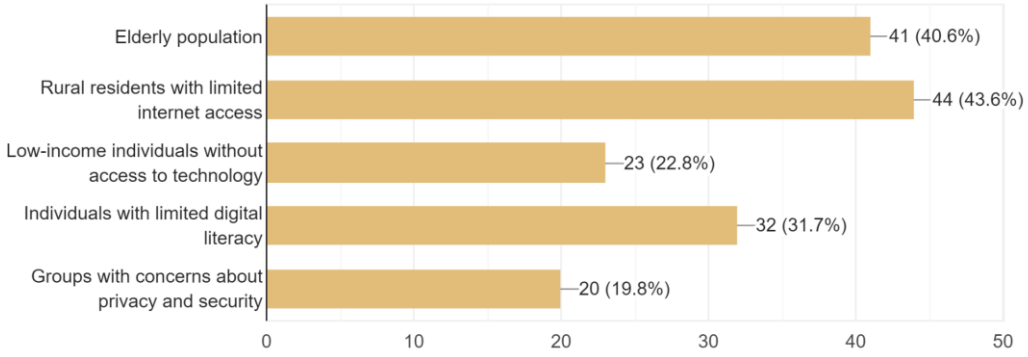
18. Which of the following groups do you believe would benefit most from the implementation of Internet voting in Azerbaijan? (Select all that apply)

101 responses



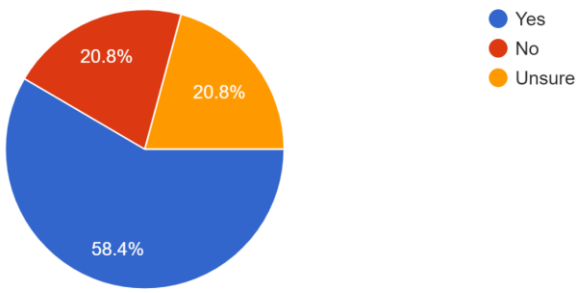
19. Which of the following groups do you believe would not benefit most from the implementation of Internet voting in Azerbaijan? (Select all that apply)

101 responses



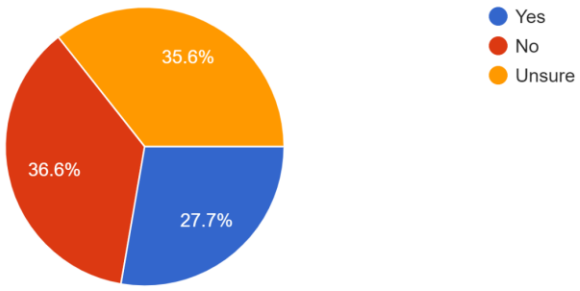
20. Do you think that Internet voting would encourage more young people to participate in elections in Azerbaijan?

101 responses



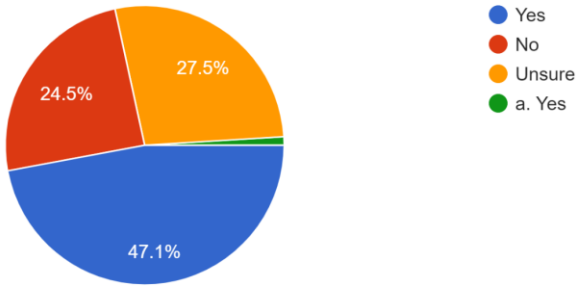
21. Do you think that Internet voting would encourage more elderly people to participate in elections in Azerbaijan?

101 responses



22. In your opinion, should the government prioritize the development of Internet voting infrastructure in Azerbaijan?

102 responses



To comprehensively extract valuable insights from the raw survey data, the "IBM SPSS Statistics" software was utilized, as it provides a wide range of analytical tools for data analysis. The "frequencies" method was employed in this survey to understand the results of question 11. The frequencies method helps to understand the data's distribution and patterns by showing how often each response or value occurs within the dataset. It can be handy for exploring categorical or ordinal variables, such as Likert scale responses, demographic characteristics, or other survey questions with a finite number of response options.

Spss analysis of the 11th question of the Survey:

Statistics

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005
N	Valid	103	103	103	103	103
	Missing	0	0	0	0	0

VAR00001

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan? [a. Security concerns]	1	1.0	1.0	1.0
	a. Security concerns, b. Lack of internet access or digital literacy, d. Voter fraud or manipulation	1	1.0	1.0	1.9
	Agree	46	44.7	44.7	46.6
	Disagree	1	1.0	1.0	47.6
	Strongly agree	50	48.5	48.5	96.1
	Strongly disagree	1	1.0	1.0	97.1
	Undiceded	3	2.9	2.9	100.0
	Total	103	100.0	100.0	

VAR00002

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	1.0	1.0	1.0
	11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan? [b. Lack of internet access or digital literacy]	1	1.0	1.0	1.9
	Agree	46	44.7	44.7	46.6
	Disagree	5	4.9	4.9	51.5
	Strongly agree	44	42.7	42.7	94.2
	Strongly disagree	2	1.9	1.9	96.1
	Undiceded	4	3.9	3.9	100.0
	Total	103	100.0	100.0	

VAR00003

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	1.0	1.0	1.0
	11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan? [c. High implementation cost]	1	1.0	1.0	1.9
	Agree	40	38.8	38.8	40.8
	Disagree	4	3.9	3.9	44.7
	Strongly agree	41	39.8	39.8	84.5
	Strongly disagree	7	6.8	6.8	91.3
	Undiceded	9	8.7	8.7	100.0
	Total	103	100.0	100.0	

VAR00005

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	1.0	1.0	1.0
	11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan? [e. Resistance from political groups]	1	1.0	1.0	1.9
	Agree	44	42.7	42.7	44.7
	Disagree	2	1.9	1.9	46.6
	Strongly agree	44	42.7	42.7	89.3
	Strongly disagree	2	1.9	1.9	91.3
	Undiceded	9	8.7	8.7	100.0
	Total	103	100.0	100.0	

Figure3.

5.2 Analyse and outcomes of Interviews

5.2.1 Interview with a Central Bank of Azerbaijan employee:

The respondent has participated in voting in Azerbaijan three times, including presidential and parliamentary elections. Implementing i-voting in Azerbaijan could bring several benefits, such as simplifying election organization, being environmentally friendly, and minimizing mistakes in the voting process.

However, he also acknowledges the challenges of implementing i-voting, such as ensuring adherence to election principles, addressing security concerns, and the possibility of coerced voting. He mentions the digital divide and the potential impact of socio-demographic factors on i-voting, which could affect certain demographic groups differently.

The respondent suggests that the Azerbaijani government should collaborate with international organizations and experts to develop a robust and secure i-voting system. He emphasizes the importance of researching and learning from other countries' experiences with i-voting systems to ensure its successful implementation in Azerbaijan.

The respondent recommends a sound and effective marketing campaign to ensure the public is well-informed about i-voting and its benefits. Although they do not expect i-voting to be implemented in Azerbaijan soon, they believe it will eventually become an inevitable reality that could impact the country's political landscape.

2. Interview with a Ministry of Labour and Social Protection of Population employee:

The respondent believes that only some people's participation in voting is reasonable, and he has participated in a voting event related to a constitutional amendment in Azerbaijan. He encountered unprofessional organizations during the process. Online voting could help those who cannot participate in elections due to distance, health issues, or other reasons. This would also reduce election-related expenses.

However, he points out that the main issue with online voting is security, and the current level of information technology in Azerbaijan makes it risky. The increase in social media users and internet literacy could positively affect online voting. The respondent suggests that international collaboration should focus on training local specialists in this area, as working with international companies for such a political issue may be risky.

Learning from international experiences is essential, and online voting could increase the number of participating voters. He believes that the news of online voting would spread quickly, mainly through social media. The current state of voting does not inspire optimism, but partially implementing internet voting could lead to more transparent elections and a healthier political environment.

3. Interview with a SOCAR employee

The author believes that transitioning to an electronic voting system in Azerbaijan could benefit the state and its citizens. The advantages of internet voting include reduced errors, timesaving, faster results, and lowered process costs. However, it is also mentioned that the state may face some obstacles while implementing this process.

With the increase in internet usage, this process can be implemented more quickly. However, most of the Azerbaijani population uses the internet for social media rather than educational purposes. The author believes that Azerbaijan can benefit from the experiences of developed countries.

While it is difficult to make precise predictions about the impact of internet voting implementation on participation, some possible effects include internet access

problems for rural residents, the older generation's lack of trust or inability to use this type of voting, and the younger generation's broader and more comfortable usage. Various methods are suggested for introducing this system to citizens and increasing its awareness, such as television and radio advertisements, SMS messages, educational videos on platforms like YouTube, and mobile applications.

The author has a positive outlook on the future of internet voting in Azerbaijan and believes that it could positively impact political change as well.

6 Discussion

The interviews with individuals from different sectors in Azerbaijan reveal a consensus regarding the potential benefits of implementing an i-voting system in the country. These benefits include simplifying the election process, environmental friendliness, reduced errors, cost savings, and increased accessibility for voters. However, the respondents also highlight the challenges of such an implementation, with security concerns being the most significant issue.

All three interviewees emphasize the importance of learning from other countries experiences and collaborating with international organizations and experts to develop a robust and secure i-voting system. They also point out the need to address the digital divide and the potential impact of socio-demographic factors on i-voting adoption. It is crucial to ensure that implementing i-voting does not disenfranchise certain demographic groups, especially those in rural areas or older citizens who may not be as comfortable using technology.

The respondents suggest various methods for promoting i-voting and raising awareness about its benefits, such as television and radio advertisements, SMS messages, educational videos on platforms like YouTube, and mobile applications. They believe that the news of the i-voting implementation would spread quickly, mainly through social media, given the increase in social media users and internet literacy in Azerbaijan. However, they also acknowledge that most Azerbaijanis use the internet for social media rather than educational purposes, which may affect the adoption of i-voting.

Regarding the political implications of i-voting, the respondents expressed mixed views. Implementing i-voting could lead to more transparent elections and a healthier political environment. In contrast, others are more cautious, stating that the current voting state does not inspire optimism. Nevertheless, they all agree that the eventual implementation of i-voting in Azerbaijan is inevitable and could impact the country's political landscape.

In conclusion, this study highlights the potential benefits and challenges of implementing an i-voting system in Azerbaijan. It underscores the importance of addressing security concerns, bridging the digital divide, and learning from international experiences. Furthermore, it emphasizes the need for a comprehensive awareness campaign to ensure the public is well-informed about i-voting and its benefits. As Azerbaijan continues to develop its information technology infrastructure and the population becomes more digitally literate, the government must consider these factors and work towards a secure, transparent, and inclusive i-voting system.

6.1 Finding and recommendations.

Based on the discussions and insights gathered from the interviews, the following recommendations can be made for the successful implementation of an i-voting system in Azerbaijan:

1. Collaborate with international organizations and experts: Engage in partnerships and cooperation with international bodies and experts in the field of i-voting to develop a secure and robust system that adheres to international best practices.
2. Invest in cybersecurity and technology infrastructure: Allocate resources to enhance the country's cybersecurity measures and improve the overall technology infrastructure to support a reliable and secure i-voting system.
3. Address the digital divide: Implement initiatives to bridge the digital divide and ensure that all citizens, including those in rural areas and older age groups, have access to the necessary technology and training to participate in i-voting.
4. Learn from international experiences: Conduct extensive research on the experiences of other countries that have implemented i-voting systems, focusing on their successes and challenges, to develop an effective model for Azerbaijan.

5. Develop a comprehensive awareness campaign: Design and execute a well-rounded marketing campaign that includes various channels such as television, radio, SMS, social media, and educational videos to inform citizens about the benefits and usage of i-voting.
6. Train local specialists: Invest in the education and training of local specialists in i-voting and cybersecurity, as relying solely on international companies for such a political issue could be risky.
7. Pilot and gradually implement i-voting: Conduct pilot tests of the i-voting system in smaller-scale elections or specific regions before implementing it nationwide, allowing for improvements and adjustments based on real-world experiences.
8. Establish a transparent monitoring and evaluation process: Set up a clear and transparent process for monitoring and evaluating the performance of the i-voting system, ensuring that potential issues and concerns are identified and addressed promptly.
9. Encourage public engagement and trust-building: Involve the public in the development and implementation process of i-voting, fostering a sense of ownership and trust in the system.
10. Monitor and adapt to changing circumstances: Continuously monitor the political, technological, and social landscape in Azerbaijan, and be prepared to adapt the i-voting system as necessary to maintain its effectiveness, security, and inclusiveness.

By following these recommendations, Azerbaijan can successfully implement an i-voting system that is secure, transparent, and accessible to all citizens, ultimately leading to a more inclusive and democratic electoral process.

Limitations and future:

The nature of the interviews conducted for this study touches upon sensitive political topics and opinions, which may have significant consequences for the respondents if their identities were to be disclosed. In light of these concerns, all interviews were conducted anonymously to ensure the safety and privacy of the participants. Anonymity in this context is crucial for fostering an open and honest dialogue, allowing respondents to share their thoughts and experiences without fear of repercussions.

By maintaining anonymity, the study gathered valuable insights into the potential benefits and challenges of implementing an i-voting system in Azerbaijan and the various perspectives of individuals from different sectors in the country. The anonymity of the respondents not only provided them with the necessary protection but also enabled the study to delve deeper into the sensitive aspects of the topic, ultimately leading to a more comprehensive understanding of the issues at hand.

It is important to note that while anonymity offers a level of protection to the respondents, it also presents certain limitations. The inability to disclose the participants' identities and affiliations may affect the findings' perceived credibility and generalizability. However, the insights gathered in this study are valuable for understanding the perspectives and concerns of key stakeholders in Azerbaijan. They can be a starting point for further research and policy discussions on implementing an i-voting system in the country.

References

1. shabani, i. (2022). E-GOVERNMENT: ITS ROLE, IMPORTANCE AND CHALLENGES.
2. Ehin, P., Solvak, M., Willemson, J., & Vinkel, P. (2022). Internet voting in Estonia 2005–2019: Evidence from eleven elections. *Government Information Quarterly*, *39*(4), 101718. https://doi.org/10.1016/j.giq.2022.101718
3. Vinkel, P. (2012). Internet Voting in Estonia. *Information Security Technology for Applications*, *7161*, 4–12. https://doi.org/10.1007/978-3-642-29615-4_2
4. A, A. (2016b, May 4). *Internet Voting System and Digital India*. Papers.ssrn.com. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2775315
5. Alvarez, R. M., & Hall, T. E. (2003). The point, Click, and Vote: The Future of Internet Voting. Washington, D.C: Brookings Institution Press.
6. Micha Germanna, Uwe Serdültb. (2017) Internet voting and turnout: Evidence from Switzerland, Electoral Studies. Pergamon.
7. *Internet voting in Estonia | Elections in Estonia*. (n.d.). Www.valimised.ee. https://www.valimised.ee/en/internet-voting-estonia
8. Alexander Trechsel, Vasyl Kucherenko and Frederico Silva (2016). POTENTIAL AND CHALLENGES OF E-VOTING IN THE EUROPEAN UNION
9. Solop, F. I. (2001). Digital Democracy Comes of Age: Internet Voting and the 2000 Arizona Democratic Primary Election. Social Science Computer Review
10. Madise, Ü., & Martens, T. (2006). E-voting in Estonia 2005: The first practice of country-wide binding internet voting in the world
11. Vassil, K., Solvak, M., Vinkel, P., Trechsel, A. H., & Alvarez, R. M. (2020). The diffusion of internet voting. Usage patterns of internet voting in Estonia between 2005 and 2015. Government Information Quarterly, 37(3), 101470.

12. Gerlach, J., & Gasser, U. (2009). Three Case Studies from Switzerland: E-Voting.
13. BBC. (2014, June 27). *E-voting experiments end in Norway amid security fears*. BBC News. https://www.bbc.com/news/technology-28055678
14. Duenas-Cid, D., Krivonosova, I., Serrano, R., Freire, M., & Krimmer, R. (2020b). Tripped at the Finishing Line: The Åland Islands Internet Voting Project. *Electronic Voting*, *12455*, 36–49. https://doi.org/10.1007/978-3-030-60347-2_3
15. Kuenzi, R. (2020, June 23). *These are the arguments that sank e-voting in Switzerland*. SWI swissinfo.ch. Retrieved March 22, 2023, from https://www.swissinfo.ch/eng/politics/e-voting_these-are-the-arguments-that-sank-e-voting-in-switzerland/45136608
16. Thomson Reuters. (2017, March 6). *France drops electronic voting for Citizens Abroad Over Cybersecurity fears*. Reuters. https://www.reuters.com/article/us-france-election-cyber-idUSKBN16D233
17. R. Michael Alvarez, Thad E. Hall and Alexander H. Trechsel**,** 2009: Internet Voting in Comparative Perspective: The Case of Estonia
18. Swiss Federal Chancellery. "E-Voting in Switzerland: Online Voting System." https://www.bk.admin.ch/bk/en/home/politische-rechte/e-voting.html.
19. Christian Bull, Henrik Nore: *Faults in Norwegian internet voting - e-vote-id.org*.
20. BBC. (2014, June 27). *E-voting experiments end in Norway amid security fears*. BBC News. Retrieved March 22, 2023, from https://www.bbc.com/news/technology-28055678
21. Specter, M., & Halderman, J. A. (1970, January 1). *Security analysis of the Democracy Live Online Voting System*. USENIX.
22. (Trechsel, A. H., & Mendez, F. (2005). The European Parliament and the Internet: A New Model of E-Democracy. In Electronic Democracy: Mobilisation, Organisation and Participation via new ICTs (pp. 93-114). Routledge).
23. (Stein, R. M., & Vonnahme, G. (2008). Engaging the Unengaged Voter: Vote Centers and Voter Turnout. The Journal of Politics, 70(2), 487-497).

24. (Gibson, R. K., Lusoli, W., & Ward, S. (2005). Online Participation in the UK: Testing a ‘Contextualised’ Model of Internet Effects. The British Journal of Politics and International Relations, 7(4), 561-583).
25. (Wolchok, S., Wustrow, E., Halderman, J. A., & Prasad, K. (2012). Attacking the Washington, D.C. Internet Voting System. In Financial Cryptography and Data Security (pp. 114-128). Springer, Berlin, Heidelberg).
26. (Jefferson, D., Rubin, A. D., Simons, B., & Wagner, D. (2004). A Security Analysis of the Secure Electronic Registration and Voting Experiment (SERVE). Unpublished report).
27. (Simons, B., & Jones, D. W. (2012). Internet Voting in the US. Communications of the ACM, 55(6), 68-77).
28. Jamieson, K. H. (2018). Cyberwar: How Russian Hackers and Trolls Helped Elect a President What We Don't, Can't, and Do Know. Oxford University Press).
29. (Schneier, B. (2000). Voting and Technology: Who Gets to Count Your Vote? Communications of the ACM, 43(11), 29-31)
30. *Use of e-voting around the world*. Use of E-Voting Around the World | International IDEA. https://www.idea.int/news-media/media/use-e-voting-around-world
31. ERR, I. K. |. (2023, March 9). *Lawyer: Riigikogu election e-vote unconstitutional, and cannot be counted*. ERR. Retrieved March 22, 2023, from https://news.err.ee/1608909464/lawyer-riigikogu-election-e-vote-unconstitutional-and-cannot-be-counted
32. Andmevara, A. S. (n.d.). *Riigikogu election act*. Riigikogu Election Act–Riigi Teataja. https://www.riigiteataja.ee/en/eli/506052016002/consolide
33. Heiberg, S., Laud, P., & Willemson, J. (1970, January 1). *The application of I-voting for Estonian parliamentary elections of 2011*. SpringerLink. https://link.springer.com/chapter/10.1007/978-3-642-32747-6_13
34. *Could internet voting halt declining electoral turnout? new evidence ...* (n.d.). https://onlinelibrary.wiley.com/doi/full/10.1002/poi3.160
35. Kristjan Vassil a, a, b, c, d, & E-voting has the potential to lower participation thresholds and increase turnout. (2016, July 12). *The diffusion of internet voting. usage patterns of internet voting in Estonia between 2005 and 2015*.

Government Information Quarterly. https://www.sciencedirect.com/science/article/pii/S0740624X1630096X

36. *A bottleneck model of e-voting: Why technology fails to boost turnout ...* (n.d.). https://journals.sagepub.com/doi/10.1177/1461444811405807
37. About Republic of Azerbaijan | CIS Legislation (cis-legislation.com)
38. Heinrich, Andreas; Meissner, Hannes,2011. Political System in Azerbaijan.
39. Andreas Heinrich, 2010. The Formal Political System in Azerbaijan and Kazakhstan: A Background Study.
40. 2b3120458bf8e5a9b0fc336af020ea78.pdf (migration.gov.az)
41. Azerbaijan's E-Government Center: http://www.e-gov.az/en/content/162/
42. "E-Government in Azerbaijan: Achievements and Challenges" by Nigar Jafarova, Journal of Information Technology Research (JITR), 2016: https://www.igi-global.com/article/e-government-in-azerbaijan/155613
43. "Asan service: Azerbaijan's model of innovative e-government" by Vusal Gasimli and Sultan Lacin, The Brookings Institution, 2017: https://www.brookings.edu/research/asan-service-azerbaijans-model-of-innovative-e-government
44. Azerbaijan e-Government Portal: https://www.e-gov.az/en/
45. UNDP Azerbaijan: e-Government: https://www.az.undp.org/content/azerbaijan/en/home/ourwork/democratic-governance-and-reform/e-governance.html
46. World Bank: Azerbaijan e-Government: https://www.worldbank.org/en/results/2019/03/29/azerbaijan-e-government
47. State Agency for Public Service and Social Innovations under the President of the Republic of Azerbaijan (2022). About Asan Service. Retrieved from https://asan.gov.az/en/about-us/
48. United Nations (2015). The Republic of Azerbaijan wins United Nations Public Service Award for improving public service delivery. Retrieved from https://www.un.org/development/desa/en/news/public-service-awards-2015.html
49. World Economic Forum (2019). Public-Private Partnership for Social Innovation: Case Studies from Azerbaijan. Retrieved from https://www.weforum.org/whitepapers/public-private-partnership-for-social-innovation-case-studies-from-azerbaijan
50. Introduction to i-voting | Elections in Estonia (valimised.ee)

51. Alvarez, R. M., Nagler, J., & Hall, T. E. (2019). Internet Voting in Comparative Perspective: The Case of Estonia. Political Science & Politics, 52(1), 1-6.

52. Chen, C., Sun, Y., & Tang, Q. (2018). Factors influencing the adoption of internet voting: A case study of a voting system in China. Government Information Quarterly, 35(1), 1-12.

53. Teixeira, R., & Ferreira, R. (2019). Online voting acceptance determinants in Portugal: A survey-based analysis. International Journal of Electronic Governance, 11(2), 133-153.

Appendix 1 – Interview Questions

1. Please Describe your experience with voting in Azerbaijan.
2. How would i-voting be integrated into it?
3. What are the key benefits of implementing Internet voting in Azerbaijan, and how would it impact the overall electoral process?
4. What are the key challenges of implementing Internet voting in Azerbaijan, and how would it impact the overall electoral process?
5. How do you think the internet penetration rate and digital literacy in Azerbaijan influence the potential implementation of internet voting?
6. How can the Azerbaijani government work with international organizations and experts to develop a robust and secure Internet voting system?
7. What lessons can Azerbaijan learn from other countries that have already implemented or experimented with internet voting systems?
8. How would implementing internet voting in Azerbaijan affect the participation of various demographics, such as rural populations, people with disabilities, and minority groups?
9. What measures should ensure the public is well-informed about the new voting method and its benefits?
10. How do you envision the future of voting in Azerbaijan with the possible implementation of internet voting, and what impact will it have on the country's political landscape?

Appendix 2 – Survey Questions

01. Please enter your current country of residence

02. What is your country of origin?

03. Please indicate your age category

04. Please select your highest education level

05. Which situation describes you best?

06. Are you familiar with the concept of Internet voting?

07. If yes, how do you know about it?

08. In your opinion, how likely can Internet voting be implemented in Azerbaijan?

09. How likely do you believe implementing Internet voting in Azerbaijan would increase voter turnout?

10. In your opinion how important is it for Azerbaijan to adopt Internet voting as an alternative voting method?

11. In your opinion, what are the main challenges to implementing Internet voting in Azerbaijan?

12. In your opinion Internet voting can be as secure as traditional, in-person voting?

13. How likely are you to use Internet voting if it becomes available in Azerbaijan?

14. What measures should be taken to ensure the integrity and security of Internet voting in Azerbaijan? (Select all that apply)

15. In your opinion Internet voting could potentially change the political landscape in Azerbaijan?

16. How concerned are you about the potential for foreign interference in Azerbaijan's Internet voting system?

17. In your opinion Digital divide (equal access to the technology) would be a problem in implementing internet voting in Azerbaijan

18. Which of the following groups do you believe would benefit most from the implementation of Internet voting in Azerbaijan? (Select all that apply)

19. Which of the following groups do you believe would not benefit most from the implementation of Internet voting in Azerbaijan? (Select all that apply)

20. Do you think that Internet voting would encourage more young people to participate in elections in Azerbaijan?

21. Do you think that Internet voting would encourage more elderly people to participate in elections in Azerbaijan?

22. In your opinion, should the government prioritize the development of Internet voting infrastructure in Azerbaijan?

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