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Challenges of i-voting – practices, rules and perspectives. Examples from Estonia and Switzerland

[1]Abstract: This paper discusses the experience related to selected European states implementing i-voting. Particular emphasis is given in the text to the issues of the definition of internet voting (as one of the forms of electronic voting); the analysis of experiences gathered by states with a history of the implementation of internet voting; and the procedures of vote casting via Internet. The main goal of this text is to answer the questions of the greatest risks and benefits of internet voting, the influence i-voting has on voter turnout and the future prospects of i-voting. The considerations presented here focus on the experiences of two states with apparently the greatest experience in the field of i-voting, namely Estonia and Switzerland.

Key words: i-voting, Internet voting, Estonia, Switzerland

T he influence of ICT on political processes and state-citizen relations is described in such terms *as digital democracy*, *cyberdemocracy*, *virtual democracy* and the most frequent one – *electronic democracy*. Whatever the term applied and its definition, all these concepts share the conviction that new technologies (ensuring interactivity, faster information transfer and feedback) allow democratic mechanisms to be influenced. Members of academia, in particular representatives of political science, primarily focus on the influence ICT has on the operation of the democratic system. The growing role of the Internet (as the most vigorously changing ICT tool) in the broadly understood politics and its increasingly significant influence on society appear to be among the crucial arguments to undertake studies in this field.

This text is therefore about the influence the Internet has on modern democracies, in particular on electoral processes. Studies on the implementation of i-voting address the recent currents of studies on the evolution of political systems (including electoral systems) as a consequence of employing ICT.

This article refers to experience related to the implementation of i-voting in selected European countries. Particular emphasis is given to the issues of the definition of internet voting (as one of the forms of electronic voting); the analysis of experiences gathered by states with a history of the implementation of internet voting; and the procedures of vote casting via the Internet. The main goal of this text is to answer the questions of the greatest risks and benefits generated by internet voting, the influence i-voting has on voter turnout and future prospects of i-voting. The considerations presented here focus on the two states with apparently the greatest experience in the field of i-voting, namely Estonia and Switzerland.
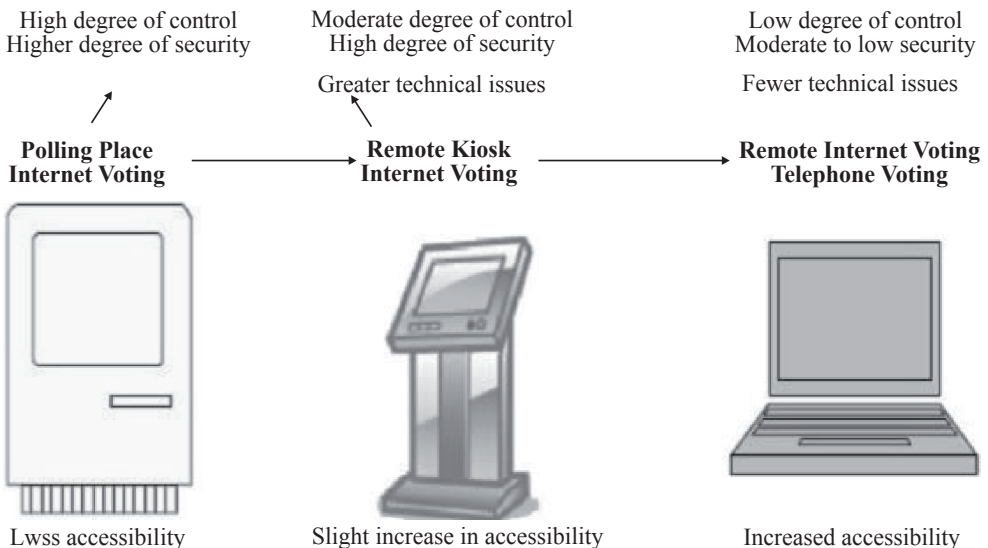
Internet voting

Electronic voting (also referred to as *e-voting*) is one of the so-called alternative forms of voting and one of the tools of electronic democracy (Krimmer, 2010, pp. 148; Musiał-Karg, 2010, pp. 156–157). In the most straightforward terms, e-*voting* means "voting by electronic means" (Kaczmarczyk, Czajkowski, 2001, p. 50). Electronic technologies employed in the voting process include primarily the Internet, telephones, television and digital platforms (Nowina-Konopka).

As concerns the different systems applied, e-voting may be classified into four types:

a) *Direct recording electronic (DRE) voting machines* with or without the option of printing out confirmation of voting (VVPAT – *voter-verified paper audit trail*). DRE voting machines with the VVPAT option supply tangible evidence of having voted;

b) *Optical Mark Recognition (OMR) systems* are based on special scanning devices able to read the votes cast by voters on special ballots, enabling scanners to operate;

c) *Electronic ballot printers (EBPs)* resemble voting machines which print out special machine-readable ballots or markers of the choice made by voters. Such ballots are fed into scanners and automatically counted;

d) **Internet voting systems** allowing votes to be transferred via the Internet to a central server that counts the votes. Voting may be performed using public computers (voting machines), so-called voting kiosks, as well as using any computer with access to the Internet (*Introducing Electronic Voting* …, 2011, pp. 10–11).

The professional literature typically divides **internet voting** into two categories: ***internet voting at the polling place*** or ***remote internet voting***. In the former type, votes are

Figure 1. Types of internet voting

High degree of control
Higher degree of security

Moderate degree of control
High degree of security

Greater technical issues

Low degree of control
Moderate to low security

Fewer technical issues

Polling Place Internet Voting   **Remote Kiosk Internet Voting**   **Remote Internet Voting Telephone Voting**

Lwss accessibility   Slight increase in accessibility   Increased accessibility

Source: *A Comparative Assessment of Electronic Voting*, http://www.elections.ca/content.aspx?section=res&dir=rec/tech/ivote/comp&document=description&lang=e#fg1, 11.10.2017.

cast at specifically designed voting kiosks by means of the Internet. The latter involves either voting from a "voting kiosk," located outside the polling station, or from any computer connected to the Internet. Figure 1 illustrates the advantages and drawbacks of each of the three types of internet voting: internet voting via voting machines in polling stations, via voting machines located outside a polling station and by means of remote voting online (using a computer or mobile phone).

Remote voting online by means of a computer or mobile phone appears to be less susceptible to various kinds of technical problems (at least on account of the small number of users – voting through computers and phones is likely to be performed by their respective owners). From the voters' perspective, the act of voting can be performed from any location at any time (*A Comparative Assessment…*). It is worth mentioning that **remote internet voting** ensures a significantly lower degree of control, which may adversely affect the level of security (personal computers are at risk of hacking attacks).

Distinguishing between representative and direct democracy, internet voting can be applied to elections (i-elections) and electronic referenda (i-referenda). In terms of technology, the latter manner of voting seems less complicated to implement, mainly because there are typically only two possible responses ("Yes" and "No") in referenda. In the case of elections, however, ballots tend to be more complex and extensive in terms of their content than those in referenda.

Considering the introduction of any form of e-voting (including **i-voting**) one has to bear in mind the fact that, depending on which form of voting is selected, it may be carried out either in a **controlled** or **uncontrolled environment**.

I-voting in a controlled environment means that votes are cast in a polling station, voting kiosk or another location monitored by the personnel representing the entity which is in charge of elections. This means that, to a large extent, an electoral administration can monitor electoral procedures, the conditions in which votes are cast and voting technologies as such. Internet voting in a controlled environment can therefore be considered to be equivalent to traditional voting on paper ballots cast in polling stations. Internet voting in an uncontrolled environment, in turn, means voting without any monitoring by the representatives of the electoral administration and without any control over the devices used to cast votes. Voters may vote using any computer or other mobile device (smartphone, tablet) with access to the Internet (*Introducing Electronic Voting…*, 2011, pp. 10–11).

The concerns related to voting in uncontrolled environments mainly refer to ensuring voting secrecy, casting votes for family members and buying votes. One of the arguments wielded by the opponents of such forms of voting is that the voting rituals are abandoned. Other arguments address such issues as the adverse impact of the digital divide on elections and the technical separation or voters' identities from ballots.

I-voting can be introduced as the only voting channel available to voters, or as an additional voting option. **Voting via the Internet** is commonly introduced as an alternative channel, whereas voting machines are typically introduced as the only channel available to voters in polling stations.

Countries experienced in i-voting

According to data from the Competence Center for Electronic Voting and Participation (E-Voting.CC GmbH), there are only a few countries worldwide which employ (or are highly advanced in implementing) remote Internet voting. It should be stressed that in each of them i-voting is a supplementary form of participating in elections and referenda, as an alternative to traditional and postal voting.

E-stonia

Estonia is a global leader in terms of employing electronic voting in elections. Since 2005, the citizens of this small country have had the option of voting through the Internet (Musiał-Karg, 2011, pp. 98–111).

The deliberations on implementing electronic voting in Estonia started at governmental level in 2001. One year later, the Estonian parliament – the National Assembly (*Riigikogu*) – provided the legislative foundations for internet voting (Goodman, Pammett, DeBardeleben, Freeland, 2010, p. 33). In summer 2003, the Estonian National Electoral Committee set about the implementation of the e-voting system project (Maaten, 2004, p. 83). In January 2000, a new law came into force regarding new identity documents (*Identity Documents Act*) which made it obligatory for citizens to obtain an *eID-card*[2] from 2002 on. Such IDs, issued by Estonian government since 2002, have the double function of providing identification and confirming electronic identity.

In order to cast their votes via the Internet, Estonian voters need a new generation ID (*eID-card*) with valid certificates (which can be revalidated online), PIN codes (issued alongside eID cards) and a computer with a reader of eID cards (and relevant software – installer.id.ee/), connection to the Internet and an operation system of Windows, MacOS or Linux (Estonian National Electoral Committee). *Mobile-ID solutions* may also be authenticated, since 2011.
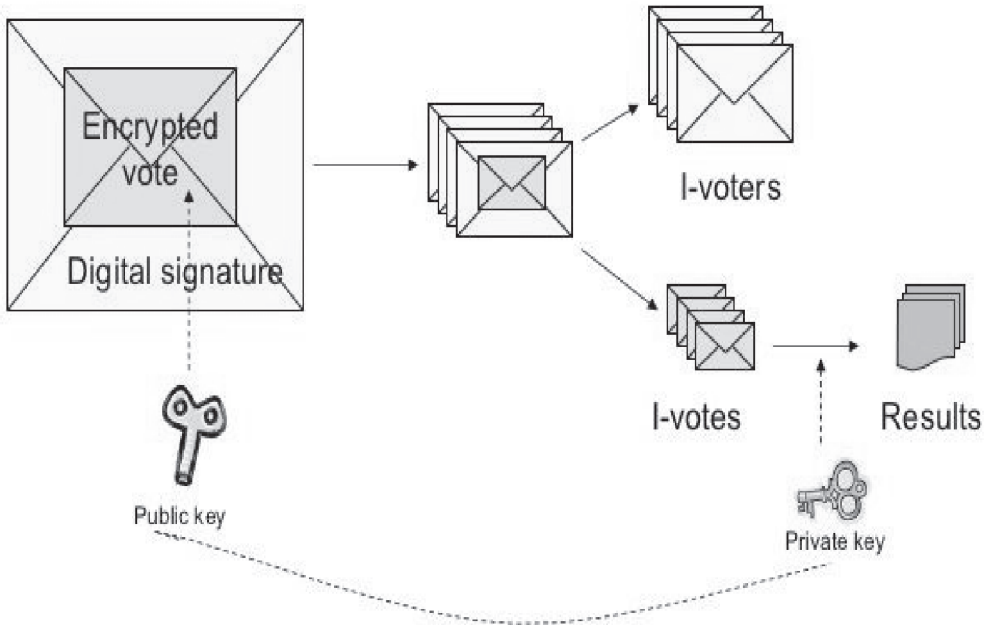
One of the crucial issues resolved when implementing the i-voting system concerned the fact that electronic voting has to resemble traditional voting as far as possible. Another prerequisite for implementing i-voting was that it complied with the law and electoral principles and was at least as secure as traditional voting (*E-Voting System. General Overview…*, 2005–2010, p. 7).

In compliance with Estonian electoral law,[3] i-voting is conducted from the 10th to 4th day before the elections. The length of this so-called *advanced voting* is necessary to ensure that double votes are eliminated by the day of voting. In order to ensure voters that they cast the vote they intended, they may change their electronic vote by means of repeated voting (before the election day) or by casting their votes in polling stations (also before elections).

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[2] In 2005 there were ca. 900,000 owners of new eID cards; Estonian National Electoral Committee, http://www.vvk.ee/index.php?id=11178&tpl=1062, 10.10.2017.

[3] *Riigikogu Election Act, Local Government Council Election Act, Referendum Act and European Parliament Election Act* – all four contain similar e-voting regulations.

Figure 2. Double envelope method in Estonian i-voting

The i-voting system in Estonia is based on the "double envelope method" otherwise typically used in postal voting (Figure 2).

As has already been mentioned, Estonia admits repeated electronic voting in elections. Over the *advanced voting* period, voters may cast their votes again and their previous vote is cancelled. The principle of assigning priority to traditional voting is of utmost significance in this context. If a voter who has cast electronic vote goes to the polling station on the day of the elections and casts his vote there, the electronic vote is cancelled.

The technical aspect of electronic (internet) voting in Estonia is required to be as simple as possible, and transparent enough to allow experts to verify its operations. According to the assumptions adopted in Estonia, the i-voting system must be repeatedly reusable, thereby allowing it to be used in successive elections without the need to design a new system employing electronic methods every time (*E-Voting System. General Overview…*, 2005–2010, p. 8).

It is worth reviewing the rationale behind the implementation of i-voting in Estonia. Crucial reasons include the following: providing a supplementary and convenient voting channel, thereby modernizing voting, and facilitating a more efficient use of the extant infrastructure (digital platforms and eID cards). In contrast to what is frequently stated, increasing voter turnout was not the purpose of i-voting in Estonia.

Nevertheless, numerous studies on i-voting emphasize its influence on the levels of voter turnout in elections.

Table 1

I-elections in Estonia – selected data

ELECTIONS	local Oct. 2005	parliamentary March 2007	Europan Parliamentary June 2009	local oct. 2009	parliamentary March 2011	local Oct. 2013	Europan Parliamentary May 2014	parliamentary March 2015
Turnout (%)	47.43	61.91	43.88	60.6	63.5	58.0	36.5	64.2
I-turnout (%) i-votes compared to the number of eligible voters in general	0.91	3.46	6.54	9.5	15.4	12.3	11.4	19.6
Proportion of i-votes compared to all votes cast (%)	1.85	5.44	14.68	15.74	24.3	21.2	31.3	30.5
I-votes distribution among all eligible voters before the election day (advanced voting)	7.2	17.6	45.4	44	56.4	50.5	59.2	59.6
I-votes cast abroad compared to all i-votes cast	n.d.	2% 51 countries	3% 66 countries	2.8% 82 countries	3.9% 105 countries	4.2% 105 countries	4.69% 89 countries	5.71% 116 countries
Duration of i-voting	3 days	3 days	7 days	7 days	7 days	7 days	7 days	7 days

Source: Author's compilation on the basis of data provided by the Estonian National Electoral Committee, http://www.vvk.ee/voting-methods-in-estonia/engindex/statistics, 10.10.2017.

The results of successive elections conducted in Estonia (whether local, parliamentary or European Parliamentary elections) demonstrate that i-voting is on the rise and growing numbers of voters in successive elections opt for voting through the Internet, as evidenced by the data in Table 1.

The proportion of Estonians who take part in elections demonstrates that whereas voter turnout has considerably dropped in the European Parliamentary elections, it has been on the rise in local elections since 2005. Voter turnout in parliamentary elections went up by 2% in 2011 (compared to the first i-voting in 2007) and by 1% in 2015 (compared to 2011). Nevertheless, it would be unjustified to conclude unanimously that i-voting translates into increased turnout. The increased participation of citizens in local and parliamentary elections has indeed been recorded, but experts are cautious about drawing conclusions (Solvak, Vassil, 2016).

Concluding, it should be noted that the following factors have influenced the successful implementation and operation of i-voting in Estonia:
– political agreement on the implementation of i-voting;
– private and public sector collaboration on designing the system;
– extensive application of eID cards (including their safe authentication);
– reasonable costs: development and implementation over four years – EUR 400,000 (the costs of the implementation of i-voting compared to the entire electoral budget accounted for 20% in 2005 and 6% in 2007) (Vinkel).

Switzerland[4] – two steps forward and one step back

Switzerland exemplifies one of the first European states to start the process of implementing voting based on new technologies. The Swiss government set about the implementation of e-voting (or rather i-voting, to be more precise) in 1998 (Braendli, 2005, p. 2).

Three pilot projects were implemented in the Swiss Confederation by 2015: Geneva, Neuchâtel and Zurich.[5] The crucial feature is that the *Vote électronique* (as the entire project is officially named) was a joint project of the Confederation and individual cantons. The first tests of i-voting started in Geneva in 2003, which was followed by Neuchâtel and Zurich. In 2008, online voting was expanded to encompass Swiss citizens residing abroad, first in Geneva, then in the other locations (Musiał-Karg, 2012, pp. 188–228). By 2015, a total of 13 cantons (forming consortia) tested three Swiss systems. Shortly before the 2015 parliamentary elections the system in Zurich did not pass a security audit. The nine cantons which had selected the Zurich E-voting System dissolved their consortium and suspended further implementation work (Serdült, 2016).

The three Swiss systems of electronic (internet) voting, Zurich, Geneva and Neuchâtel, differed in terms of their respective structures, but the most crucial steps (stages) in voting were very much alike in all the three systems. Possessing a document authorizing voting (and containing the data required for electronic voting), a voter typed in his identification (user ID) or ballot number and chose the appropriate answer to the referendum question, then he typed in the PIN code featuring on his ballot and a password concealed by a scratch strip and sent his vote. The procedure ended with him receiving confirmation that the vote had been cast.

The primary goal of implementing e-voting in the Swiss Federation was to provide eligible voters with a supplementary platform to cast votes in referenda and elections, and, later on, to enable them to electronically sign motions related to people's initiatives, referenda and submitting candidate lists before parliamentary elections. E-voting primarily targeted young people who use the Internet (who tended not to have voted before) and those voters who were unable to take part in voting (for instance, due to physical disability). Another crucial target group was Swiss citizens abroad.

After the Zurich canton faced security issues regarding i-voting, work on the Neuchâtel system was also suspended. Nevertheless, a decision was made on the level of the entire Federation to continue work on the Geneva system and a new e-voting system proposed by the Swiss Post (*Swiss Post's e-voting solution…*).

At present i-voting is being tested in six cantons. Three offer e-voting only to Swiss voters residing abroad. The Geneva and Neuchâtel cantons make i-voting available also to some voters residing domestically. Since June 5, 2016, in the Basel-Stadt canton, i-voting has been available not only to Swiss citizens residing abroad but also to the disabled residing in this canton.

It can therefore be concluded that, over varying periods, so far 14 cantons have offered internet voting to Swiss citizens residing abroad. Three cantons (Neuchâtel, Geneva and

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[4] For more on e-voting in Switzerland see: M. Musiał-Karg, 2012.

[5] The projects use modern technologies to varying degrees. They facilitate voting in elections and referenda via the Internet, among other things, but also via text message (SMS).

Basel-Stadt) launched electronic voting systems for Swiss residents. Statistics indicate that ca. 60% of citizens eligible for electronic voting have actually used this option.

Current regulations in Switzerland impose quantitative limitations on i-voting: a maximum of 10% of votes may be cast electronically in referenda and 30% in general votes on amendments to the Constitution. Currently, the Swiss Post and the Geneva canton are offering and testing internet voting systems that might be employed in Switzerland (*Swiss e-voting poised…*, 2017).

Voting via the Internet – arguments of supporters and opponents[6]

Considerations on the implementation of i-voting lead to the analysis of the reasons and potential benefits, as well as threats stemming from i-voting (Krimmer, 11.03.2010).

The most advantageous change that may brought by i-voting concerns increased voter mobility. This voting system enables them to cast votes from any place at any time (within the limits stipulated by legislation) even when they are away from their place of residence. Additionally, new technologies boost the convenience of voting, as voters are no longer required to leave their homes to go to polling stations (or to post offices in the case of postal voting). Internet voting is also beneficial for the disabled, who frequently find it difficult to reach polling stations.

From the administrative perspective, electronic voting can potentially accelerate vote counting and improve counting precision. In this context, the elimination of errors committed by electoral officers is emphasized, as is vote rigging in polling stations. Introducing an electronic voter register system may additionally eliminate the cases of multiple voting which happen occasionally; in countries that have not introduced e-voting yet (for instance RIV) a central electronic voter register could be the first stage on the path to introducing i-voting (Rakowska, Rulka, 2011, p. 14).

I-voting systems in countries with the central electronic voter registers can help slash the costs related to the organization of elections and referenda. This is justified by the fact that i-voting does not require huge numbers of electoral officers, who are indispensable in the case of traditional elections (in polling stations), to be employed in polling stations.

The introduction of the Internet into elections has triggered a debate on the weaknesses of i-voting. This is confirmed, among other things, by the fact that many countries have expressed their concern about electronic voting leading to mass electoral frauds.

Another essential problem concerns the identification of voters. On the one hand, a password and electronic signature should be considered helpful at the stage of voting. On the other hand, one needs to be aware that they may not necessarily be used by the voter but by third parties.

Moreover, internet voting systems are susceptible to many technical problems. They may be subjected to attacks, leading to considerable disruption of the voting process. Thus, the servers, systems, computers and voting kiosks should be sufficiently protected to prevent any hacks and infections with computer viruses.

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[6] For more see: M. Musiał-Karg, 2012, pp. 173–176.

An analysis of the literature on electronic voting makes it possible to identify the most frequent strengths and weaknesses of i-voting mentioned there. Most of them are listed in the table concluding a part of the report drawn up by the Swedish International Institute for Democracy and Electoral Assistance, titled *Introducing Electronic Voting: Essential Considerations*.

Table 2

Strengths and weaknesses of electronic voting

Strengths of electronic voting	Weaknesses of electronic voting
• Faster vote count and tabulation. • More accurate results as human error is excluded. • Efficient handling of complicated electoral systems formulae that require laborious counting procedures. • Improved presentation of complicated ballot papers. • Increased convenience for voters. • Potentially increased participation and turnout, particularly with the use of Internet voting. • More attuned to the needs of an increasingly • mobile society. • Prevention of fraud in polling stations and during the transmission and tabulation of results by reducing human intervention. • Increased accessibility, for example by audio ballot papers for blind voters, with Internet voting as well for housebound voters and voters from abroad. • Possibility of multilingual user interfaces that can serve a multilingual electorate better than paper ballots • Reduction of spoilt ballot papers as voting systems can warn voters about any invalid votes (although consideration should be given to ensuring that voters are able to cast a blank vote should they so choose). • Potential long-term cost savings through savings in poll worker time, and reduced costs for the production and distribution of ballot papers. • Cost savings by using Internet voting: global reach with very little logistical overhead. No shipment costs, no delays in sending out material and receiving it back. • Compared to postal voting, Internet voting can reduce the incidence of vote-selling and family voting by allowing multiple voting where only the last vote counts and prevent manipulation with mail-in deadlines through direct control of voting	• Lack of transparency. • Limited openness and understanding of the system for non-experts. • Lack of agreed standards for e-voting systems. • System certification required, but no widely agreed standards for certification. • Potential violation of the secrecy of the vote, especially in systems that perform both voter authentication and vote casting. • Risk of manipulation by insiders with privileged access to the system or by hackers from outside. • Possibility of fraud through large-scale manipulation by a small group of insiders. • Increased costs for both purchasing and maintaining e-voting systems. • Increased infrastructure and environmental requirements, for example, with regard to power supply, communication technology, temperature, humidity. • Increased security requirements for protecting the voting system during and between elections including during transport, storage and maintenance. • Reduced level of control by the election administration because of high vendor- and/or technology-dependence. • Limited recount possibilities. • Need for additional voter education campaigns. • Possible conflict with the existing legal framework. • Possible lack of public trust in e-voting-based elections as a result of the weaknesses above.

Source: *Introducing Electronic Voting: Essential Considerations*, International Institute for Democracy and Electoral Assistance, Policy Paper, December 2011, pp. 8–9.

Conclusions

Voting via the Internet is becoming an increasingly debated/considered way of voting in elections and referenda. This is evidenced by the fact that many states have recently begun discussing the implementation of i-voting and conducting test and pilot votes to examine the operation of i-voting. The most frequently mentioned advantage of i-voting concerns increased convenience for voters who can cast their votes from a PC connected to the Internet at any place and any time as stipulated by the electoral committee. This is particularly significant for the disabled and for those who are abroad on voting day.

Estonia is a country that in 2005 successfully implemented internet voting in local, parliamentary and European Parliamentary elections. It is the only country across the globe giving access to i-voting to every eligible voter.

Switzerland is another state that has seriously tested and advanced internet voting. Having faced security issues related to the Zurich E-voting System Switzerland resolved to suspend further system tests and hand the task over to the Swiss Post. At present, the i-voting system in Switzerland is being implemented on the basis of the systems developed by the Geneva canton and Swiss Post.

I-voting procedures vary. Most systems resemble e-banking. Votes are cast via specifically designed online portals. Estonia requires an eID card or ID Mobile to be used in order to cast votes via the Internet. In the Swiss system of the Geneva canton it is necessary to have a ballot with proper codes allowing voters to be authenticated.

It is too early still to make conclusions on the influence i-voting has had on voter turnout. A certain, moderate influence is observed in the case of turnout in local elections and a minimal influence on the parliamentary elections in Estonia, but these results are difficult to be equivocally interpreted. As the number of elections involving i-voting grows, it is necessary to expand studies on the influence of i-voting on voter turnout. It should be stressed that practically no change has been recorded in Switzerland which has conducted a number of i-voting tests.

The most significant risks related to the implementation of i-voting in elections are related to technology. The argument that the opponents of internet voting wield most frequently concerns hacking attacks. There are also accusations that the level of the electoral administration's control over i-voting is lower, which results from the fact that voting takes place in what are named uncontrolled environments.

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Wyzwania i-głosowania – praktyka, zasady funkcjonowania i perspektywy. Przykład Estonii i Szwajcarii

Streszczenie

Przedmiotem niniejszego tekstu są doświadczenia związane z wdrożeniem i-votingu w wybranych państwach Europy. W tekście zwrócono szczególną uwagę na zagadnienia związane z: definiowaniem głosowania internetowego (jako jednej z form głosowania elektronicznego); analizą doświadczeń państw, mających doświadczenia związane z wdrożeniem internetowego głosowania czy procedurom oddawania głosów za pośrednictwem głosowania internetowego. Głównym celem niniejszego tekstu jest odpowiedź na pytania o najważniejsze ryzyka i korzyści związane z głosowaniem przez Internet, o wpływ i-voting na frekwencję wyborczą, jak i o przyszłe perspektywy stosowania i-voting. Rozważania w niniejszym tekście koncentrują się na doświadczeniach dwóch państw z największym – jak się wydaje – doświadczaniem w obszarze i-voting, tj. Estonii oraz Szwajcarii.

Słowa kluczowe: i-voting, głosowanie przez Internet, Estonia, Szwajcaria