Internet voting: A research agenda

Adrià Rodríguez-Pérez

Author ORCID Nr: 0000-0002-5581-1340
CNSC Research Group, Universitat Oberta de Catalunya, Rambla del Poblenou, 156, 08018 Barcelona.
arodriguezperez4@uoc.edu

Beata Martin-Rozumiłowicz

Independent Electoral Expert. ElectConsult, 123 Crescent Road, Oxford OX4 2NY, UK.
rozumil@hotmail.com

David Duenas-Cid

Author ORCID Nr 0000-0002-0451-4514
Kozminski University, Pub-Tech Research Center, 57/59 Jagiellońska, 03-301 Warszawa, Poland.
dduenas@kozminski.edu.pl

Thomas Hofer

OS Objectif Sécurité SA, Route Cité-Ouest 19 - CH-1196 Gland, Switzerland.
thomas.hofer@objectif-securite.ch

Iuliia Spycher-Krivonosova

Author ORCID Nr: 0000-0001-7246-1373
University of Bern, KPM Center for Public Management, Schanzeneckstrasse 1, 3012 Bern, Switzerland.
iuliia.spycher@unibe.ch

1. Introduction to the first E-Vote-ID's special issue at the eJournal of eDemocracy and Open Government (JeDEM)

The year 2024 marks a special anniversary in the e-voting calendar. Two decades ago, in 2004, the seed of E-Vote-ID was planted during a workshop on "Electronic Voting in Europe – Technology, Law, Politics and Society", held in July in SchloßHofen/Bregenz, Austria. The year 2004 marks as well the adoption of the first international standard on e-voting, the Council of Europe's Recommendation Rec(2004)11 of the Committee of Ministers to member States on legal, operational and technical standards for e-voting. The year 2024 could also well serve as the 20th anniversary of

a milestone in the history of internet voting since it was in 2004 when this technology was first used during the initial trials of internet voting for federal votes in Switzerland as well as during the European Parliamentary elections in the Netherlands.[1]

The unique path that these three phenomena have followed could very well represent the evolution of e-voting itself. The follow-up to that workshop in Bregenz was combined, year to year, with its sister conference series, Vote-ID (of a more technological nature), until both conferences merged in 2019 into today's E-Vote-ID. E-Vote-ID itself has also changed and is now taking place in different locations in Europe, evidencing the growing scope of voting technologies. The Council of Europe's recommendation also grew, with a series of biennial reviews, new sets of guidelines on certification and transparency of e-voting and e-enabled elections, respectively, and even an e-voting handbook. However, time has shown that a comprehensive update was necessary, and Rec(2004)11 was replaced by Recommendation CM/Rec(2017)51 of the Committee of Ministers to member States on standards for e-voting.[2] In turn, the updated Recommendation has also been expanded with a set of Committee of Ministers' Guidelines on using information and communication technology (ICT) in electoral processes in Council of Europe member States.[3] This aims to provide guidance on using those election technologies not included in the updated Recommendation.

Studying the complete evolution of how internet voting has been adopted by governments all over the world could deserve its very own special issue. However, an overview of developments in some countries easily shows that it has followed anything but a straight evolutionary path (for an overview of Estonia, France, and Switzerland, see Rodríguez-Pérez, 2022). For example, in Switzerland, the internet voting pilots have been subject to continuous regulatory changes and new technological developments, and the very use of the systems itself has been halted not once but twice (at the national level, internet voting was stopped between 2019 and 2023, but previously there was also a long-term interruption in the canton of Geneva that lasted from 2005 to 2009). Throughout this period, the number of cantons offering e-voting also changed substantially, starting with 3, followed by a record peak of 15 in 2015, and currently being used in 4. Switzerland is not the only country experiencing this unpredictable trend. Its French neighbours, for example, have also experimented with different avenues, mainly for voters living abroad, including a major reform in 2012. France also halted the use of internet voting during the 2017 legislative elections, even if it shortly after resumed the initiative that continues to date. In other countries, this has not been the case. The Australian state of New South Wales seems to have stopped internet voting after the 2021 local elections, following a decade of elections in which voters with special needs were able to cast their votes over the Internet; Norway completely stopped internet voting pilots following the 2011 and 2013 elections, usually considered the first ones in which end-to-end verifiability was offered (Puiggalí et al., 2017). So did the Netherlands after voters abroad were allowed to vote online in the 2004 European

---

[1] Even if 2004 was undoubtedly not the first time that internet voting was being used for governmental elections. For example, municipalities in the Canadian province of Ontario had already used it a year before, and it was also in 2003 that the first partial election to the Assembly of French Citizens Living Abroad allowed for the use of internet voting. In fact, even in Switzerland itself internet voting had already been used in 2003 during a test by residents of Anières.

[2] https://rm.coe.int/0900001680726f6f

[3] https://search.coe.int/cm?i=0900001680a575d9

Parliament elections and the national elections of November 2006 (Loeber, 2008). Other experiences have been even more short-lived, such as the e-voting pilot in Finland in 2008, and not to mention that e-voting in the Aland Islands was finally not even implemented, with a last-minute cancellation ahead of the 2019 elections (Duenas-Cid et al., 2020; Rodríguez-Pérez, 2020). The often-cited exception to this trend is Estonia, where internet voting has been continually offered since 2005 and where the number of online voters has also steadily increased to become the main voting channel (Krimmer et al., 2021). Exceptions can also be found elsewhere, especially at the local level in the Canadian provinces of Ontario and Nova Scotia, where the number of municipalities offering online voting is not only growing considerably but where the technology is also spill-over into other branches of government, namely territorial and provincial (Goodman et al., 2023).

In view of these developments, therefore, there is no doubt that the first special issue of the E-Vote-ID conference series at the eJournal of eDemocracy and Open Government (JeDEM) could not come at a better time. It may help further illuminate these two decades of e-voting practices through empirical research on the governance aspects of e-voting as well as on the election and practical experiences with e-voting and digital election technologies.

2. The papers in the special issue

This special issue contains six papers. The first four papers are extended versions of papers accepted at the 2023 E-Vote-ID Conference. The special issue additionally includes two publications close to the topics discussed in this annual conference.

The paper by Samuel Agbesi, Jurlind Budurushi, Asmita Dalela, and Oksana Kulyk builds on their contribution to the technical track of E-Vote-ID 2023, proof that the technological and governance aspects of digital electoral technologies often overlap. Their contribution is threefold: a taxonomy of transparency in internet voting based on five dimensions (information availability, understandability, monitoring and verifiability, remedial measures, and testing); the "Transparency Dimensions of Internet Voting" (TDIV) questionnaire, meant to measure voters' assessments of the five dimensions of transparency in internet voting; and an online user study based on this novel framework involving 500 participants. Their findings are twofold. Quantitatively, they find that the strongest correlations with transparency are remedial measures, followed by testing, monitoring and verifiability. Qualitatively, they further explore different measures valued by potential i-voters linked to each of the five dimensions in their taxonomy.

David Duenas-Cid, Leontine Loeber, Beata Martin-Rozumiłowicz and Ryan Macias use four case studies (the United States of America, the Netherlands, Poland, and Kenya) to bring attention to the interactions between trust, distrust and technology throughout the election cycle. In their work, they describe and locate elements bringing trust and distrust in the different moments of the electoral cycle and point on some interesting directions for further investigation: how trust-related factors perform in different stages of implementation, the complicated relation between the understandings of trust and trustworthiness, the role of ancillary systems in the provision of trust or the uneven impact between trust and distrust producers.

Next, Adrià Rodríguez-Pérez, Núria Costa, and Tamara Finogina expand their contribution to E-Vote-ID 2023. Their interdisciplinary research explores why internet voting systems have not yet been secured against the growing threat of quantum computing. Against their initial assumption, however, they discover that internet voting is not the only area where post-quantum cryptography is still far from being implemented. Using a combination of desk research and 18 interviews with 24 experts, the authors navigate the complex world of quantum-resistant internet voting. Their findings highlight issues revolving around different stakeholders' perceptions of quantum computing as a threat; the relationship between quantum computing, internet voting, and election technologies; how to transition toward post-quantum cryptography; aspects related to interagency collaboration; as well as the importance of trust and understanding in election technologies.

The contribution by Iuliia Spycher-Krivonosova, Nicole Goodman, and Aleksander Essex investigates the election administrators' perceptions and understanding of verifiable online voting and its use in local elections in Ontario, Canada, from an interdisciplinary perspective of political, computer and public administration scientists. Given that most municipalities in Ontario do not offer verifiability options to its online voters, this article delves into considerations and challenges of introducing verifiability mechanisms in local elections through three focus groups with local governments in Ontario, Canada: (1) users of verifiable online voting systems, (2) users of non-verifiable systems, and (3) those without online voting. This contribution reflects on the deeper reasonings for selecting non-verifiable online voting systems, such as administrators' perceptions of voters' needs and the perceived value of transparency, and suggests promoting the value and meaning of verifiability among all stakeholders.

Christinah Kenosi, Irina Zlotnikova, and Tshiamo Sigwele provide a comprehensive review and analysis of existing literature on e-government frameworks, focusing on utilising Industrial Revolution 4.0 technologies. Their thorough contribution compares 11 e-government frameworks and their adoption of 10 different technologies: big data, blockchain, deep learning, cloud computing, the Internet of Things, machine learning, artificial immunity, cognitive computing, natural language processing, and robotics/process automation. Their analysis reveals that big data analytics and blockchain were the most incorporated technologies in the studies that they reviewed. In turn, and by identifying gaps in current frameworks, their paper provides a roadmap for developing more robust, scalable, and adaptable e-government solutions.

Lastly, Felix-Christopher von Nostitz, Marie Neihouser, Giulia Sandri, and Tristan Haute explore French voters' opinions on the potential introduction of internet voting for Presidential elections. Whereas internet voting is already used in France, both for some governmental representatives for French citizens abroad as well as in private setting, the further adoption of this technology in the country has stalled. In spite of the lack of advances, the authors find considerable support for the internet (60,8% of citizens would use this option if it were available for voting in the presidential election, compared to 30,7% who could not use it). Furthermore, the authors also delve into the reasons why people would or would not use internet voting, as well as perceptions about internet voting based on socio-economic profile, political attitudes, and technological literacy.

Overall, issues related to transparency and trust remain salient. These are indeed prevalent ideas in the e-voting discourses in the policy-making circles, among technologists, and in academia. Proof of this prevalence is provided in the papers by Agbesi et al., Duenas-Cid et al., Spycher-Krivonosova, Goodman, and Essex, as well as Von Nostitz et al. At the same time, however, little is known about what we mean by such concepts as "transparency" and "trust", as well as their interplay. These four papers, then, help dilucidated these important issues. In this regard, Agbesi et al. not only break down the notion of transparency into five dimensions but also offer a framework for analysing voter attitudes towards internet voting. These findings can be read in conjunction with those by Von Nostitz et al., who find that security concerns are still the most salient concern among those who are against using internet voting (61,1% of their sample considers that internet voting is less secure than voting in polling stations). However, this must also be balanced against the fact that the rejection of internet voting stems more from political reasons - individuals' level of interest in politics and their ideological positioning- than social ones. Lastly, Duenas-Cid et al. expand this assessment to the use of technologies throughout the electoral cycle. Their paper zooms out to examine how trust and distrust influence the implementation of a broad range of election technologies throughout the electoral cycle.

At the same time, however, transparency measures come with their problems, and technological proposals may not always travel well into the practice of policymaking and the administration of elections. As Spycher-Krivonosova, Goodman, and Essex noted, the introduction of end-to-end verifiability in Canadian municipal elections might come with its burdens for electoral officers. Additionally, some election organisers perceive excessive transparency and accessibility in election processes may not always be beneficial. Transparency may also carry risks in the long term. Understanding the long-term challenges to internet voting is precisely the contribution of Rodríguez-Pérez, Costa, and Finogina, who explore the development and implementation of internet voting technologies under the potential threat posed by quantum computers. Indeed, using novel technologies and innovations in elections and democratic processes can be a double-edged sword. This is the main contribution of Kenosi, Zlotnikova, and Sigwele, who expand the toolbox of available technologies for e-government ecosystems also to explore the potential of artificial intelligence, blockchain technologies, etc. How to accommodate, then, the need for more transparent elections with the challenges this creates for election administrators today as well as in the future? The contributions in this special issue may provide some sound grounds to work on solid proposals at the intersection of social sciences and the development of information and communication technologies.

3. The views of the editors

3.1. The sociological approach, by David Duenas-Cid

Research on internet voting is inherently multidisciplinary: a technological innovation contributing to a very political field, framed by a legal framework, and with obvious societal implications. This richness is both represented by the editors of this Special Issue and by the papers included and is also, at the core of JeDEM as a journal. The papers included in this Special Issue explore the undeniable societal impacts of internet voting differently. Agbesi et al. discuss the implications and

user perception around transparency; Duenas-Cid et al. focus on the deeply sociological concept of trust and how it evolves in different moments of the electoral cycle; Rodríguez-Pérez, Costa, and Finogina focus on the expert's perceptions about the use Quantum technologies; and Von Nostitz et al. on the perceptions of French citizens regarding the use of internet voting.

Sociology as a discipline provides solid foundations for approaching technological topics, and having them on the table is more important than ever. Technological developments are often shacking previous understandings and patterns of functioning and dealing with our everyday lives. At the same time, technology provides a huge amount of data to explore the impacts of those changes, but analysing such data requires a sociological perspective to connect the conclusions to human behaviour adequately. This Special Issue, rich in disciplines and perspectives, serves as a good example of how can sociological concepts be enmeshed within technological environments, adding value to the final outcome. Moreover, this trend should continue, sociological academic tradition is rich in theoretical constructs that can be applied to the understanding of digital technologies and, specifically, to the use of internet voting and tackling still open questions in the field. Just to put one example, the academic community still has not found a clear answer to the question of whether internet voting increases turnout, but we still lack sociological research on the determinants of the use of internet voting amongst non-traditional voters. We can find research on how the habits of voters change (Solvak & Vassil, 2018) or on how willing-to-vote but traditionally excluded participants benefit from a more convenient system (Germann, 2021), but the focus has never been put on those not willing to participate and who might be attracted by a less costly voting method such as internet voting.

3.2. On the regulation of internet voting and election technologies, by Adrià Rodríguez-Pérez

The papers in this special issue identify important lessons for regulating internet voting and, more broadly, digital technologies. Because voters' perceptions of internet voting are often neglected at the regulatory level, the findings by Agbesi et al. can become important guidelines in developing i-voter-centric electoral standards. According to the authors, what has the strongest correlation with transparency are remedial measures, which they found to be linked to aspects such as notification about breaches, assurances about the security of votes/personal data, openness, support for the voters, accountability, and re-voting. These findings are, therefore, evidence that some of the obligations that already exist for handling personal data (spanning from the communication of breaches to the sacrosanct principle of accountability) should be translated to election regulations. Alternatively, because personal data regulations already applied to internet voting, more attention could be paid to the interaction between these two sources of obligations.

Kenosi, Zlotnikova, and Sigwele stress the importance of establishing regulatory standards and guidelines, viewing them as essential for the ethical and secure implementation of technology in public administrations. In spite of their importance, they also highlight a significant gap in the comprehensive coverage of security and privacy issues in the implementation of technology in e-government, which calls for a more comprehensive assessment of the regulatory dimensions. Similarly, Duenas-Cid et al. extensively address challenges with regulatory frameworks, particularly focusing

on the role of courts during post-electoral periods. Their case studies on election technologies in the United States and Kenya illustrate the importance of judicial oversight, with courts mandating respectively manual recounts and an election re-run. While case law on e-voting has already been explored in detail (Driza-Maurer and Barrat, 2015), there is now an opportunity also to examine how courts address both the implementation of ancillary technologies throughout the electoral process as well as those that have become prevalent in electoral processes, such as social media platforms and messaging apps, search engines, as well as the increasingly widespread AI-driven chatbots.

3.3. A practitioner's approach, by Beata Martin-Rozumiłowicz

This special issue is especially important as it also examines practical aspects of the application of technology that are very relevant to the practioner community and for international organisations involved in the area of technical assistance on various aspects of democracy, elections and good governance. Introducing e-voting, i-voting, and technology in ancillary systems (voter registration, results management systems, etc.) is something that is actively being discussed and considered in a number of countries globally. So, too, is the issue of voter trust and confidence and how this is either buttressed or undermined through how technology is introduced. An analysis of these crucial elements of the election-technology nexus is indispensable to this discussion.

References

Driza Maurer, Ardita, & Barrat, Jordi (2015) E-Voting Case Law: A Comparative Analysis. Routledge.

Duenas-Cid, D., Krivonosova, I., Serrano, R., Freire, M., & Krimmer, R. (2020). Tripped at the finishing line: The åland Islands internet voting project. In International Joint Conference on Electronic Voting (pp. 36-49). Cham: Springer International Publishing.

Germann, Micha (2021). Internet Voting Increases Expatriate Voter Turnout. Government Information Quarterly 38(2):101560.

Goodman, N., Spycher-Krivonosova, I., Essex, A., & Brunet, J. (2023). Verifiability Experiences in Ontario's 2022 Online Elections. In International Joint Conference on Electronic Voting (pp. 87-105). Cham: Springer Nature Switzerland.

Krimmer, R., Duenas-Cid, D., & Krivonosova, I. (2021). New methodology for calculating cost-efficiency of different ways of voting: is internet voting cheaper?. Public money & management, 41(1), 17-26.

Loeber, Leontine (2008) E-voting in the Netherlands; from general acceptance to general doubt in two years. 3rd International Conference, Co-organized by Council of Europe, Gesellschaft für Informatik and E-Voting.CC, August 6th-9th, 2008 in Castle Hofen, Bregenz, Austria

Puiggalí, Jordi, Cucurull, Jordi, Guasch, Sandra, Krimmer, Robert (2017). Verifiability Experiences in Government Online Voting Systems. In: Krimmer, R., Volkamer, M., Braun Binder, N., Kersting, N., Pereira, O., Schürmann, C. (eds) Electronic Voting. E-Vote-ID 2017. Lecture Notes in Computer Science(), vol 10615. Springer, Cham. https://doi.org/10.1007/978-3-319-68687-5_15

Rodríguez-Pérez, Adrià (2020). My Vote, My (Personal) Data: Remote Electronic Voting and the General Data Protection Regulation. In: Krimmer, R., et al. Electronic Voting. E-Vote-ID 2020. Lecture Notes in Computer Science, vol 12455. Springer, Cham. https://doi.org/10.1007/978-3-030-60347-2_11

Rodríguez-Pérez, Adrià (2022) Secret texts and cipherballots: secret suffrage and remote electronic voting. PhD Dissertation in the framework of the Programme in Law, Universitat Rovira I Virgili (Tarragona, Spain). http://hdl.handle.net/10803/675606

Solvak, Mihkel & Vassil, Kristjan (2018). Could Internet Voting Halt Declining Electoral Turnout? New Evidence That E-Voting Is Habit Forming. Policy & Internet, 10, 4-21.

About the Authors

Adrià Rodríguez-Pérez

Political scientist and jurist with a PhD cum laude in Electoral Law and Information and Communication Technologies from Universitat Rovira i Virgili. His research focuses on the intersection of digital technologies, fundamental rights, and their (global) governance. He currently holds the position of Legal Advisor, specialised in Electoral Law at the European Commission for Democracy through Law (Venice Commission). He is an External Associate Researcher at the Communication Networks & Social Change (CNSC) Research Group of the Universitat Oberta de Catalunya.

Beata Martin-Rozumiłowicz

Dr. Beata Martin-Rozumiłowicz is an International Electoral Expert with two and a half decades of election observation and technical assistance experience. She has been Deputy Chief Observer on EU EOMs to Zimbabwe (2023), Kenya (2022), and The Gambia (2021/2022). Previously, she was Director for Europe and Eurasia at IFES in Washington, D.C. and also headed OSCE/ODIHR's Election Department in Warsaw, Poland. Beata has co-authored OSCE/ODIHR's new ICT Handbook and is currently working on a special edition on updating political party assistance strategies together with a number of academics and practitioners, soon to be published in Policy Studies.

David Duenas-Cid

Associate Professor and Director of the Public Sector Data-Driven Technologies Research Center at Kozminski University (Poland). President of the Working Group on Digital Sociology at the International Sociological Association, General Chair at the E-Vote-ID Conference, Program Chair at the Annual International Conference on Digital Government Research and Mini-Track Chair on e-Democracy, e-Participation and e-Voting at the Hawaii International Conference on System Sciences.

Thomas Hofer

IT Security Consultant at OS Objectif Sécurité SA.

Iuliia Spycher-Krivonosova

Iuliia Spycher-Krivonosova is a postdoc at the Competence Center for Public Management at the University of Bern, Switzerland. She is a part of the interuniversity research group under the leadership of Prof. Dr Adrian Ritz, working on the research project "The role of governance in public sector digitalisation", funded by the Swiss National Science Foundation. Her research has been published in leading outlets, such as Policy Studies, Public Money and Management, Election Law Journal, and Lecture Notes in Computer Science. Before joining the University of Bern, she worked as a Junior Research Fellow at the Tallinn University of Technology, Estonia and as a Scientific Consultant for Brock University, Canada, focusing on electronic voting. Outside academia, she serves as a consultant for governmental and international organisations such as the Organization for Security and Cooperation in Europe or the International Institute for Democracy and Electoral Assistance on the questions of digitalisation.