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Free to Choose: E-voting, Infrastructure and the Origins of Estonia's Digital Republic

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In the 2000s, Estonia's self-avowedly neoliberal government institutionalised voting over the internet, becoming the only country in the world to use online voting in national elections. This innovation was branded as a key component of Estonia's 'digital republic', articulated as an alternative to the bulky welfare state as well as to Soviet authoritarianism. This article suggests that by focusing on the sociotechnical infrastructure that underpinned the e-voting project, specifically the Estonian digital ID, we can reframe the history of post-Cold War development. It argues that reforms of post-Soviet state institutions were driven by a fragile coalition of civil servants, looking for ways to accomplish new challenges under serious budgetary constraints, computer engineers, who shared an ethos of experimentation developed at the Soviet-era Institute of Cybernetics, and banks, who offloaded their R&D initiatives to the state. This coalition was fraught with conflict, did not last long and had no singular goal – and thus could later be framed as a victory for democratic reform as well as another example of state capture by private interests. Further, the infrastructural basis of e-voting helps explain how Estonian policymakers could defend the institutions against criticisms that prevented its widespread adoption elsewhere.

Introduction

In October of 2005, Estonia held its first local elections where voters could cast their ballots entirely online.¹ Two years later, the state made internet voting available in national elections, making Estonia the only country in the world where e-voting was open to all voters at the highest level.² Conservative Prime Minister Mart Laar celebrated the initiative as 'a tool for creating equal and additional opportunities, for strengthening and developing Estonian democracy'.³ Despite legal challenges and vigorous political debate, this assessment seems to have been accurate. In the 2023 national elections, over half of all votes were cast online (Figure 1).⁴ Internationally and at home, e-voting has become one of the central pillars of Estonia's 'digital republic', which its champions typically describe as a set of digital

¹ Full disclosure: as an Estonian citizen living in the United States, I have regularly used the e-voting platform since 2011 and find it extremely convenient.

² Piret Ehin et al., 'Internet Voting in Estonia 2005–2019: Evidence from Eleven Elections', *Government Information Quarterly* 39, no. 4 (1 Oct. 2022): 101718, <https://doi.org/10.1016/j.giq.2022.101718>.

³ Mart Laar, informational session at the Estonian parliament, 17 Jan. 2002, Riigikogu stenogramm (RK).

⁴ Urmet Kook and Huko Aaspõllu, 'E-hääled moodustasid Reformierakonna tulemusest 68 protsenti, EKRE-l 28 protsenti', ERR, March 6, 2023, <https://www.err.ee/1608906002/e-haaled-moodustasid-reformierakonna-tulemusest-68-protsenti-ekre-l-28-protsenti>.

Percentage of votes cast online in major Estonian election (out of all participating voters)

Parliamentary 2023	51.10%
Local 2021	46.90%
European 2019	46.70%
Parliamentary 2019	43.80%
Local 2017	31.70%
Parliamentary 2015	30.50%
European 2014	31.30%
Local 2013	21.20%
Parliamentary 2011	24.30%
Local 2009	15.80%
European 2009	14.70%
Parliamentary 2007	5.50%
Local 2005	1.90%

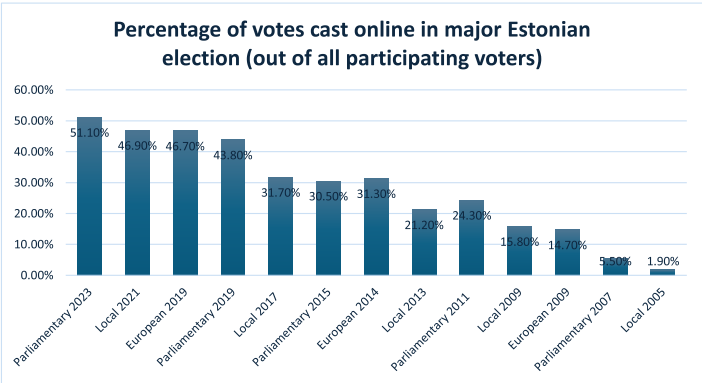


Figure 1. Online votes cast in municipal, national and European elections from 2005 to 2023.

Source: National Electoral Commission (*Vabariigi Valimiskomisjon*).

public services that represent ‘the most ambitious project in technological statecraft today’, promising to ‘fundamentally redefine what it means to be a country’.⁵

‘What it means to be a country’ is, of course, a question with a vibrant historiography. Voting is certainly one of the constitutive elements of modern states, the proof of participation in representative democracies according to political theory, and, in the words of one historian, an act with a ‘solemn character’ that states and citizens treat as a sacred ritual.⁶ The secret ballot, in its present socio-material arrangement, has its roots in mid-nineteenth-century Australia, where it was instituted as part of colonial self-rule.⁷ Though states have tended to emphasise the continuity of voting principles (such as secrecy and uniformity), scholars have increasingly called attention to the struggles that have shaped many innovations in voting technology, from reconfiguring the layout of the ballot to the introduction of voting machines.⁸

Many political scientists have seen Estonia’s digital democracy projects as a natural by-product of technological progress, driven by ‘by the hope to increase voter turnout, attract younger voters, and make voting more convenient’.⁹ These scholars form part of a larger chorus calling for a broader

⁵Nathan Heller, ‘Estonia, the Digital Republic’, *New Yorker*, 11 Dec. 2017, <https://www.newyorker.com/magazine/2017/12/18/estonia-the-digital-republic>; Ben Hammersley, ‘Concerned about Brexit? Why Not Become an e-Resident of Estonia’, *Wired*, 27 Mar. 2017, <https://www.wired.co.uk/article/estonia-e-resident>.

⁶Yves Deloye and Olivier Ihl, *L'acte de vote* (Paris: Sciences Po, 2008), 35.

⁷Mark McKenna, *Building a Closet of Prayer in the New World: The Story of the Australian Ballot*, No. 6, ed. Carl Bridge and Susan Pfisterer (London: Institute of Commonwealth Studies, 2002).

⁸For an overview of the history of voting technologies, one might start with the following: Malcolm Crook, *How the French Learned to Vote: A History of Electoral Practice in France* (New York: Oxford University Press, 2021); Malcolm Crook and Tom Crook, ‘Reforming Voting Practices in a Global Age: The Making and Remaking of the Modern Secret Ballot in Britain, France and the United States, c.1600–c.1950’, *Past & Present* 212, no. 1 (2011): 199–237; Peter Pels, Jean-Louis Briquet and Romain Bertrand, eds., *Cultures of Voting: The Hidden History of the Secret Ballot* (London: C Hurst & Co Publishers, 2007); Roy G. Saltman, *The History and Politics of Voting Technology: In Quest of Integrity and Public Confidence* (New York: Palgrave Macmillan US, 2006), <https://doi.org/10.1057/9781403977212>.

⁹Ehin et al., ‘Internet Voting in Estonia 2005–2019’; Robert Krimmer, Stefan Triessnig and Melanie Volkamer, ‘The Development of Remote E-Voting Around the World: A Review of Roads and Directions’, in *E-Voting and Identity*, ed. Ammar Alkassar and Melanie Volkamer, Lecture Notes in Computer Science (Berlin, Heidelberg: Springer, 2007), 1–15,

revitalisation of democracy via digitisation, such as Citizens Assemblies, various computer-powered direct democracy initiatives, online public services and so forth.¹⁰ In this view, digitisation offers solutions to the widespread dissatisfaction recorded in Western democracies, overcoming their 'deliberative deficits', the feeling of the public of being excluded from decision-making in spite of increasing numbers of formal mechanisms for participation.¹¹ Estonia's construction of a 'digital republic', which includes, in addition to e-voting, services ranging from tax filing to medical aid, is portrayed in this telling as a deliberate strengthening of popular sovereignty.

This view is at odds with the standard historiography on post-Soviet statecraft. Historians generally describe the post-1991 period as one of increasing, if circumscribed, neoliberalisation. In Quinn Slobodian's account, neoliberalism is characterised by not so much the championing of markets over state power but rather 'redesigning states, laws, and other institutions to protect the market', in particular from national sovereignty and mass democracy.¹² Key to this transformation has been the empowerment of experts and technocrats over electoral politics, a trend that holds true both in Eastern Europe and elsewhere.¹³ Of course, the vision of a world made predictable and safe from the tempers of national publics has always been more of an idealised vision than fully implemented reality. As reformers in Russia, the Baltics and elsewhere discovered, institutions and infrastructures resisted complete recalibrations, and neoliberals had to, as Stephen Collier put it, learn to work *through* the actually existing state, which retained many of the attributes of Soviet socialism.¹⁴ Nor was the neoliberal revolution a complete break with the past, since, as Johanna Bockman has shown, post-1989 reformers co-opted ideas about 'market transitions' developed by economists on both sides of the Iron Curtain into their practices.¹⁵

Remarkably, scholars of neoliberalism have had very little to say about voting. The founding fathers of the thought collective certainly had their reservations about universal suffrage: Milton Friedman, John Davenport and William Hutt all supported restrictions on suffrage in South Africa in order to 'immunize the market against the disruptive effects of an empowered population.'¹⁶ One could argue that it is precisely *because* neoliberals have been so successful in constructing supranational institutions to constrain national sovereignty that they have no interest in elections as such – no matter who wins, the ruling parties still have to play by rules made at the WTO or the European Commission. Yet it is surely worth investigating why e-voting in Estonia came into existence during the government of Mart Laar, a politician so committed to neoliberalism that he has repeatedly claimed that the only

https://doi.org/10.1007/978-3-540-77,493-8_1; Wolfgang Drechsler and Ülle Madise, 'Electronic Voting in Estonia', in *Electronic Voting and Democracy: A Comparative Analysis*, ed. Norbert Kersting and Harald Baldersheim (London: Palgrave Macmillan UK, 2004), 97–108, https://doi.org/10.1057/9780230523531_6.

¹⁰Sandford Borins et al., *Digital State at the Leading Edge* (Toronto: University of Toronto Press, 2007), <https://doi.org/10.3138/9781442685468>; Massimo Di Felice, *Digital Citizenship: The Crisis of the Western Idea of Democracy and the Participation on Digital Networks* (Milan: Mimesis International, 2022); Stephen Coleman and Jay G. Blumler, *The Internet and Democratic Citizenship: Theory, Practice and Policy*, Communication, Society and Politics (Cambridge: Cambridge University Press, 2009), <https://doi.org/10.1017/CBO9780511818271>; Henry Milner, *The Internet Generation: Engaged Citizens or Political Dropouts*, Civil Society: Historical and Contemporary Perspectives (Medford, MA: Tufts University Press, 2010).

¹¹Coleman and Blumler, *The Internet and Democratic Citizenship*, 14.

¹²Quinn Slobodian, *Globalists: The End of Empire and the Birth of Neoliberalism* (Cambridge: Harvard University Press, 2020), 6, 8–12.

¹³Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002); Gil Eyal, Iván Szelenyi and Eleanor Townsley, 'The Theory of Post-Communist Managerialism', *New Left Review* (1997): 60–92; Stephen Collier, *Post-Soviet Social* (Princeton: Princeton University Press, 2011).

¹⁴Collier, *Post-Soviet Social*, 3–10; Philipp Ther, *Europe since 1989* (Princeton: Princeton University Press, 2017), 77–160.

¹⁵Johanna Bockman, *Markets in the Name of Socialism: The Left-Wing Origins of Neoliberalism* (Stanford: Stanford University Press, 2011).

¹⁶Slobodian, *Globalists*, 151.

work of political philosophy he had read when he became prime minister was Milton Friedman's *Free to Choose*.¹⁷

To understand the genesis of e-voting, this article takes seriously the 'building' in 'state-building' and looks at how the infrastructure required for online voting was developed in the 1990s and early 2000s. This approach is informed by work in science and technology studies that conceptualises infrastructure – the basic technological building blocks that invisibly enable the functioning of contemporary society – as sociotechnical systems, composed of hardware, as well as institutions, laws, cultural practices and maintenance work that make the hardware function, or at least appear to function, smoothly and without friction.¹⁸ I argue, contrary to the digital republic's cheerleaders, that, rather than being the culminating step in a grand vision of democratic renewal, e-voting is best understood as a peripheral by-product of a different digital infrastructural project that brought together both public and private interests – the digital ID. Indeed, in the same speech in which Prime Minister Laar touted the benefits of e-voting for equal opportunity, democracy and so forth, he also underscored how basic democratic principles, like the secret ballot or one person, one vote, were safeguarded by 'the passing of the digital ID law in the Parliament'.¹⁹ In the context of the history of neoliberalism, my approach argues for understanding the neoliberal turn as one mediated and shaped by the construction and reappropriation of sociotechnical infrastructure, rather than driven principally by individual actors or a 'neoliberal thought collective'.²⁰ The infrastructure in question not only framed and set limits to ideology but also, indeed, created the conditions of possibility for ideological utterances, thus explaining the seeming contradictions of the Estonian 'digital republic' project.

Centring infrastructure in the story of online voting helps us better both to appreciate the historical conjuncture that enabled the emergence of this particular project in the first place and to explicate how the specific material and discursive qualities of digital identification shored up support for the online voting project, enabling its success in Estonia while similar projects failed elsewhere. The State Chancellery developed the physical and computational architecture for digital identification in the early 2000s, in a public–private partnership with Estonian banks and telecommunications companies. The latter saw this initiative essentially as an opportunity to outsource the development costs of their own authentication infrastructure for online banking onto the state. Meanwhile, civil servants understood the digital ID programme as a tool for simplifying queries to national registries,

¹⁷ 'Mart Laar Receives Milton Friedman Prize', 1 July 2006, <https://www.cato.org/policy-report/july/august-2006/mart-laar-receives-milton-friedman-prize>.

¹⁸ Key works in this field include Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences*, rev. ed. (Cambridge, MA: MIT Press, 2000); Susan Leigh Star et al., *Boundary Objects and Beyond: Working with Leigh Star*, ed. Geoffrey C. Bowker et al. (Cambridge, MA: MIT Press, 2016); Thomas P. Hughes and Renate Mayntz, *The Development of Large Technical Systems* (Boulder: Westview Press, 1988); Langdon Winner, 'Do Artifacts Have Politics?', *Daedalus* 109, no. 1 (1980): 121–36. On computing and infrastructure, Paul N. Edwards, 'Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems', in *Modernity and Technology*, ed. Thomas J. Misa, Philip Brey and Andrew Feenberg (Cambridge, MA: MIT Press, 2003), 185–225; see Paul N. Edwards, 'Platforms Are Infrastructures on Fire', in *Your Computer is on Fire: Critical Perspectives on Computing and New Media*, ed. Thomas Mullaney and Benjamin Peters (Cambridge, MA: MIT Press, 2021), 313–337; Didier Bigo, Engin Isin and Evelyn Ruppert, eds., *Data Politics: Worlds, Subjects, Rights* (New York: Routledge, 2019). A call for more materialist histories of voting can be found in Deloye and Ihl, *Lacte de vote*, 10–13.

¹⁹ Mart Laar, informational session at the Estonian parliament, 17 Jan. 2002, RK.

²⁰ The theory of neoliberalism focusing on the role of political ideology is represented, for instance, in the work of Philip Mirowski, *Never Let a Serious Crisis Go to Waste: How Neoliberalism Survived the Financial Meltdown* (London: Verso, 2013); Loïc Wacquant, 'Three Steps to a Historical Anthropology of Actually Existing Neoliberalism', *Social Anthropology/Anthropologie Sociale* 20, no. 1 (1 Feb. 2012): 66–79, <https://doi.org/10.1111/j.1469-8676.2011.00189.x>. My approach is closer to the STS analysis used by Michel Callon and Fabian Muniesa, 'Peripheral Vision: Economic Markets as Calculative Collective Devices', *Organization Studies* 26, no. 8 (1 Aug. 2005): 1229–50, <https://doi.org/10.1177/0170840605056393>; Timothy Mitchell, 'The Work of Economics: How a Discipline Makes Its World', *European Journal of Sociology / Archives Européennes de Sociologie / Europäisches Archiv Für Soziologie* 46, no. 2 (2005): 297–320.

which expanded as the state took over functions that had previously been performed in Moscow and tried to comply with EU regulations in advance of accession. Although the state made new digital ID cards compulsory for the entire population, few citizens initially used them. The following discussion argues that for many stakeholders, online voting became a means of revitalising the ID card programme. Voting, in other words, became the problem that digital identification could solve.

The sources for this article include sixty oral history interviews conducted in 2021 with individuals deeply involved in building Estonia's digital republic. These include civil servants, politicians, lawyers and engineers but also entrepreneurs, CIOs and CEOs of major banks and telecommunication firms. These interviews were commissioned by the Estonian Ministry of Communications and Economic Affairs, and the list of interviewees was developed in consultation with the ministry; however the semi-structured interviews themselves were conducted, together with Raivo Ruusalepp, in private and without oversight. I have complemented these sources with archival material from the State Chancellery and records from the State Information Agency, various ministries and published sources. The article first looks at the genesis of the digital ID programme in various state offices in the 1990s in response to internal and international pressures. I then survey its transformation into a tool for banks and telecoms in the turn of the millennium. Finally, I look at how particular features of the digital ID infrastructure were mobilised to respond to critics of e-voting both at home and abroad.

The Infrastructure Under the Success Story

Understanding why Estonia's compulsory digital ID programme became so central to the success of online voting requires a look under the hood of the system itself. From the perspective of the voter, the process looks as follows. In local, national and European elections, voters can vote online during the period of early voting using any internet-connected computer with a smart-card reader (Figure 2). Voters download an app, authenticate themselves with the ID card, view the list of candidates running in their district, choose their preferred candidate and confirm their choice with a digital signature authenticated, once again, with the ID card. To protect the secrecy of voting, voters can change their online votes an unlimited number of times until the end of the election period, and a vote cast at a polling station will override a ballot cast online, rendering, as the architects of the system argue, any voter intimidation meaningless (Figure 3).²¹

On the back end, online voting most closely resembles double envelope postal voting. Information about the voter's choice is encrypted using a public key generated by the central voting system, and it is attached to the 'outer envelope', containing the voter's digital signature. The information is then sent to the central voting system over the internet. At the time of counting, provided that the voter has not voted in person, the 'outer envelope' is dropped, the information is decrypted using the server's private key (stored in a hardware security module) and the vote is added to the overall tally.²² Several security and verification mechanisms prevent tampering with the system. Voters can verify that their vote has actually been recorded by the server.²³ Election monitors and auditors verify that the raw voting data is recorded, in line with regulations, onto DVDs, that the processing of votes is done on computers disconnected from the internet, that different components of the voting system's private key are sealed, that the seals are unbroken prior to use, that the standard rules of cybersecurity are followed and so on.²⁴

Over the years, the system has been overhauled and modified to reduce security risks. Still, as even the developers themselves have admitted, the risks of e-voting can only be minimised and

²¹ Ehin et al., 'Internet Voting in Estonia 2005–2019'.

²² Sven Heiberg and Jan Willemson, 'Verifiable Internet Voting in Estonia', in *2014 6th International Conference on Electronic Voting: Verifying the Vote (EVOTE)*, Lochau: IEEE, 2014, 1–8, <https://doi.org/10.1109/EVOTE.2014.7001135>.

²³ Heiberg and Willemson, 'Verifiable Internet Voting in Estonia'.

²⁴ Hanno Lindpere and Mihkel Kukk, *Riigikogu Valimised 2019. Elektroonilise Hääletamise Protsessi Auditeerimine* (Tallinn: KPMG Baltics OÜ, 2019), 4.



Figure 2. The Estonian ID card. Front and back.
Source: The Police and Border Authority (Politsei Ja Piirivalveamet).

not entirely eliminated. Critics have argued that the e-voting system has ‘serious procedural and architectural weaknesses’ from the vulnerability of voters’ computers, which could potentially be

The screenshot shows the Estonian e-voting interface. At the top, there are four tabs: 'Sisenemine' (Login), 'Tutvustus' (Information), 'Valiku tegemine' (Making a choice), and 'Hääletamine' (Voting). The 'Valiku tegemine' tab is active. On the left, under 'Sisenemine', there is a list of political parties: Eesti Vabaerakond, Eesti Reformierakond, Erakond Eestimaa Rohelised, Sotsiaaldemokraatlik Erakond, Elurikkuse Erakond, Eesti Konservatiivne Rahvaerakond, Erakond Eesti 200, Eesti Keskerakond, Eestimaa Ühendatud Vasakpartei, Isamaa Erakond, and Üksikkandidaadid. On the right, under 'Hääletamine', there is a section 'Kelle valite Riigikokku?' (Whom do you choose for the Riigikogu?). Below this, it says 'Klõpsake soovitud valikul.' (Click on the desired candidate.). Then, 'Teie valimisringkond:' (Your electoral region:) is shown, followed by 'Valimisringkond nr. 5: Hiiu-, Lääne- ja Saaremaa' (Electoral region no. 5: Hiiumaa, Läänemaa, and Saaremaa). Below that, it says 'Minu valik on:' (My choice is:). At the bottom, there is a text input field labeled 'Otsi:' (Search:), a button with an 'X' icon, a 'Katkestan' (Cancel) button, and a 'Valin' (Choose) button.

Figure 3. The e-voting GUI. The left column contains party lists in a randomised order. The right column lists the voters' electoral region and confirms their candidate choice. After choosing their preferred candidate, the voter clicks on 'choose', authenticates themselves with the ID card and their PIN and the ballot is encrypted, sealed in a virtual double envelope and transmitted to the NEC's server.

contaminated by malware to the potential of server-side attacks, where third parties could break into the vote-counting servers and alter votes between decryption and tabulation.²⁵ Architects of the system have admitted that the security of the computers used for voting is indeed left to the conscience of the voters themselves. They also argue that risks to other components of system, such as tampering with DVDs used for tabulating votes, while 'theoretically possible', are as likely as a 'neutron bomb arriving by train [to the centre of the capital] or the Sun suddenly going extinct'.²⁶ Official analyses have found the system to be in compliance with EU rules on 'traditional' voting, and some researchers have even argued that e-voting has more risk management built into it than paper-based voting mechanisms.²⁷

Still, Estonia remains the only country using e-voting in national elections. E-voting has been used sporadically in Switzerland, Norway, Germany, Canada and elsewhere, usually in local-level elections, and states have often discontinued the practice due to security concerns (Figure 4). It should be distinguished from other types of electronic voting, such as casting ballots in polling stations that use vote-counting machines.²⁸ Researchers studying the persistence of Estonia's e-voting practices

²⁵Drew Springall et al., 'Security Analysis of the Estonian Internet Voting System', in *Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security* (Scottsdale, AZ: ACM, 2014), 2, <https://doi.org/10.1145/2660267.2660315>.

²⁶Anto Veldre, 'Sel nädalal alanud järjekordne rünnak e-valimiste vastu on poliitiline, mitte tehniline', Delfi, accessed 3 Apr. 2023, <https://www.delfi.ee/a/68671703>.

²⁷Arne Ansper, 'E-Hääletamise Kontseptsiooni Turve: Analüüs Ja Meetmed' (Tallinn: Vabariigi Valimiskomisjon, 2010); Kristjan Kriips, 'Privacy and Coercion-Resistance in Voting' (PhD thesis, Tartu University, 2022), <https://dspace.ut.ee/handle/10062/81829>.

²⁸Saltman, *The History and Politics of Voting Technology*; Paul S. Herrnson et al., *Voting Technology: The Not-So-Simple Act of Casting a Ballot* (Washington, DC: Brookings Institution Press, 2007).

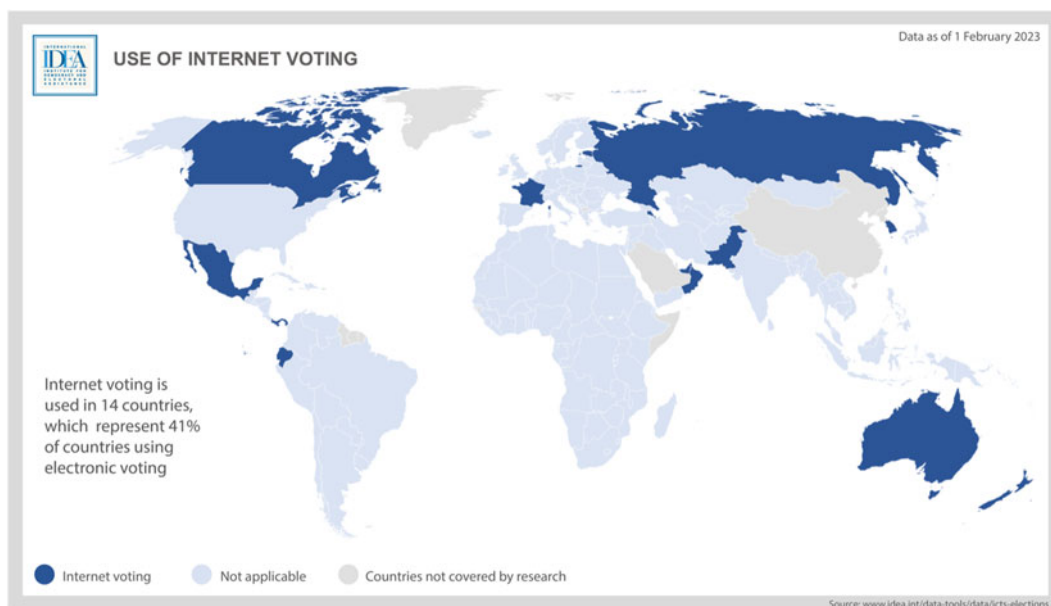


Figure 4. Countries that use online voting in regional or national elections.

Source: International Institute for Democracy and Electoral Assistance.

have repeatedly returned to the same key difference: the added layer of security provided by the digital ID system, which allows voters to securely authenticate themselves using a smart card and a series of PIN numbers.²⁹ Other online voting systems have used passwords delivered through the postal system (Switzerland), IDs tied to mobile phone numbers (Norway), or other more complicated methods.³⁰ Estonia has integrated digital identification into various government e-services, further lowering barriers to entry.

Put simply, much of the trust placed in the Estonian e-voting system is based on the country's unique infrastructure of digital identification, which is universal, compulsory and tied to a physical ID card. The process by which this system of identification came into being, however, was far from meticulously planned. The following discussion reveals how the development of what became touted as a novel experiment in the future of democracy relied on a specifically post-Soviet alignment of business interests, public sector reformers and cyberneticians.

Bureaucrats Face the Information Age

The groundwork for Estonia's digital ID system was built in the 1990s, when dozens of researchers at the Institute of Cybernetics found themselves relocating from the quintessentially Soviet-looking mass housing district of Mustamäe to the historical buildings in the Old Town of Tallinn, which housed ministries and departments of the once-again sovereign Republic of Estonia. The Institute was founded in 1960 on the order of Gustav Naan, a polymath, tech enthusiast and, by all accounts, relentless womaniser. Naan was known for, among other things, editing the *Estonian Encyclopedia*, authoring numerous articles on extraterrestrial life and championing the works of Norbert Wiener, including writing an introduction to the Estonian translation of *Human Use of Human Beings*:

²⁹ Mihkel Solvak and Kristjan Vassil, *E-Voting in Estonia: Technological Diffusion and Other Developments over Ten Years (2005–2015)* (Tartu: Johan Skytte Institute of Political Studies, 2016), 48.

³⁰ Ehin et al., 'Internet Voting in Estonia 2005–2019', 3–4.

Cybernetics and Society.³¹ Cybernetics, which frames interactions between humans, animals and machines as issues of communication and control that could be facilitated via computers, offered an exciting new language for scientists to talk about reforms in the Soviet system.³² In Estonia, the Institute of Cybernetics brought together an eclectic group of heterodox thinkers who worked on issues ranging from urban planning to cryptography, often simultaneously.³³ The Institute was led by Nikolai Alumäe, an engineer working at the Energy Institute of the Academy of Sciences, who saw an increasing need for digital computers in the petrochemical sector of eastern Estonia.³⁴ They were also among a small number of experts in computing with experience working in a market society, thanks to a long-standing collaboration with Finnish engineers, who built many of the microelectronics used in the Soviet Union. Some even had experience in politics.³⁵ No wonder, then, that both private companies and the state quickly poached many of these researchers once the Institute was forced to downsize after 1991.³⁶ Take, for instance, Tarvi Martens, a young engineer whose career began with working on the Institute of Cybernetics's Juku line of PCs in the late 1980s, before transitioning into cryptography, a long-time interest of the Institute's chief, Ülo Jaaksoo. When work at the Institute became scarce, Martens shuffled around various private companies for a few years, before being invited to build registries for the state's borders and customs agency.³⁷

Registries are central to the history of the digital state. Nineteenth-century statisticians in the United Kingdom, France, Germany and the United States argued that the aggregation of informational statistics – on births, deaths, marriages, income, ownership, criminality, health and much more – was vital for modern governments. Basic tasks depended on such data. The state might, for instance, have to confirm that citizen A indeed owned the piece of land they claimed to own.³⁸ By the 1950s, Western governments collected massive amounts of data on their citizens. By the 1970s, this information was increasingly stored electronically on large mainframe computers held by agencies like the UK Benefits Agency or the Social Security Administration in the United States. In the 1990s, these organisations began to move their data onto personal computers and interlinked registries, promising a future of ever more precise forecasting of demographic and economic trends, as well as cheap and efficient processing of citizen information.³⁹

Nothing like this had taken place in Soviet Estonia. Attempts to build a pan-Union system of inter-networked data registries had been started in the 1970s but failed.⁴⁰ A development centre founded by the State Chancellery in 1989 studied the information processing capacities of what would soon become independent Estonia and concluded in 1992 that the government of 'the Republic is completely lacking in centralized registries [...] and due to the incredible development of computing power, our information systems are falling even further behind those of Western states'.⁴¹ Estonia

³¹For more on Naan's biography, see Toomas Karjahärm and Väino Sirk, *Kohanemine Ja Vastupanu. Eesti Haritlaskond 1940–1987* (Tallinn: Argo, 2007); For Naan's essay on cybernetics, see Norbert Wiener, *Inimolendite Inimlik Kasutamine. Küberneetika Ja Ühiskond* (Tallinn: Loomingu Raamatukogu, 1969).

³²Ben Peters, *How Not to Network a Nation: The Uneasy History of the Soviet Internet* (Cambridge, MA: MIT Press, 2016); Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, MA: MIT Press, 2004).

³³Aro Velmet, 'The Blank Slate E-State: Estonian Information Society and the Politics of Novelty in the 1990s', *Engaging Science, Technology, and Society* 6 (2020): 162–84, <https://doi.org/10.17351/ests2020.284>.

³⁴Mati Kutser, ed., *Küberneetika Instituut Muutuvas Ajas* (Tallinn: TTÜ Küberneetika Instituut, 2000), 30–3.

³⁵Ants Urvak, interview with the author, 16 Nov. 2021, Eesti Rahvusrhiiv (ERA) 5446.33540.

³⁶Urmas Kõlli, interview with the author, 16 Aug. 2021, ERA.5446.33518; Indrek Neivelt, interview with the author, 11 Aug. 2021, ERA.5446.33509; Aare Lapõnin, interview with the author, 3 Aug. 2021, ERA.5446.33502.

³⁷Andres Kütt, *print(memcpy[])*: *Eesti IT-inimeste lugusid* (Tallinn: TeamConsulting OÜ, 2022), 152–5; Tarvi Martens, interview with the author, 17 Aug. 2021, ERA.5446.33521.

³⁸Jon Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, MA: MIT Press, 2016), 118; Ian Hacking, *The Taming of Chance* (Cambridge: Cambridge University Press, 1990); Joshua Cole, *The Power of Large Numbers: Population, Politics, and Gender in Nineteenth-Century France*, illust. ed. (Ithaca: Cornell University Press, 2000).

³⁹Helen Margetts, *Information Technology in Government: Britain and America* (London: Routledge, 1998), 52–89.

⁴⁰Peters, *How Not to Network a Nation*.

⁴¹Programm Eesti NSV Valitsuse infosüsteemi arendamiseks, 2–3, ERA 5046.1.11125.



Figure 5. Tarvi Martens.

Source: Estonian National Archives, ERA.5446.df.33521.

lacked a functioning population registry, a registry of enterprises, a centralised tax board and a customs registry. Other registries existed in the form of punch cards and indexes or were incompatible with Western standards – sometimes both. The State Chancellery was faced with a dual challenge: after the collapse of the Soviet market, the country was in a constant state of near bankruptcy, and there was hardly any cash to pay for pensions, let alone to modernise the state; yet jumpstarting the economy and integrating with Western markets was itself contingent on a functioning and dependable system of registries and economic statistics. For many officials, digitisation was the only way to break this gridlock.⁴²

As the number of new electronic registries multiplied, engineers like Martens, with experience in cryptography, began to ask questions about the security and reliability of documents that were now being exchanged increasingly in the form of bits and bytes. How could someone at the tax board, for instance, be certain that a certificate of ownership issued electronically by the land cadastre was actually accurate? How could the authenticity of electronic documents be verified in the same way as a signature and timestamp could confirm the authenticity of a printed document? Answering these questions, of course, also meant more work for the engineers and their colleagues: if Martens could impress the importance of secure authentication on government officials, the Institute of Cybernetics and its offshoots were likely to get the contracts to actually build the system.⁴³ The issue was internationally prominent, too. The state of California passed the world's first law on electronic signatures in 1995, Germany passed similar legislation in 1997, and the European Union, in the mid-nineties, was in the process of drafting directives to regulate digital signatures. In response to growing local and international pressure, a small group of civil servants, including Martens, began work on developing Estonian legislation in early 1998 (Figure 5).⁴⁴

Martens does not immediately appear charismatic. He speaks quietly, fidgets and, as I discovered during our interview, has a habit of referring to himself in the third person. At the same time, he speaks with confidence and can explain the most complex issues in cryptographies to fairly uninitiated audiences. Nearly everyone we interviewed brought him up unprompted as a key figure in getting the ID card project off the ground, from his first meeting with Migration Agency officials who had a vague idea of introducing some kind of electronic ID once the first set of Estonian passports was due

⁴² Imre Siil, interview with the author, 16 Aug. 2021, ERA.5446.33517.

⁴³ Ahto Buldas, interview with Raivo Ruusalepp, 15 Dec. 2021, ERA.5446.33558.

⁴⁴ 'Elektrondokumendi seaduse väljatöötamiseks moodustatud komisjoni koosoleku protokoll nr 8/98', 2 Apr. 1998, ERA.5046.1.9020. See also Ivar Tallo, interview with Raivo Ruusalepp, 24 Sept. 2021, ERA.5446.33524.

to expire in 2002. At first, the civil servants were interested mostly in simplifying their own workflows. Once most government registries were operating digitally, civil servants imagined a system of data exchange, where governmental and municipal institutions could send and receive documents with timestamps and signatures, speeding up legislative and administrative reviews, rights confirmations and so on. The project soon expanded to encompass interactions with citizens as well, facilitating already existing online service (like e-tax filing) and adding new ones.⁴⁵

The working group converged around the idea of a microchipped ID card, based on the model of public key cryptography, which dated back to British intelligence experiments in the 1970s and has now become the standard model for online encryption.⁴⁶ The card would contain a secure private key that could be used to generate unique stamps on digital documents. A second vital component in this system is a Certification Authority, which associates digital IDs with specific people and holds the repository of public keys used to verify the authenticity of a specific signature.⁴⁷ And the person who led the engineering side of this gambit – none other than Tarvi Martens.

As the project developed, it became clear that neither the microchipped ID card nor the infrastructure for the certification authority would come cheap. As a result, there was little enthusiasm for the project among political elites, who saw it as an expensive and overly technical ‘nice-to-have’. It was not a vote winner.⁴⁸ This tension might have become an insurmountable obstacle for the cash-strapped state – were it not for the interest of the banking sector in the success of the project.

The Bankers’ Gambit

In the first ten years of the young market economy, the financial sector became a considerable force in Estonian society and politics. The first commercial banks were founded in 1988–9, but it was not until the early nineties when banking in Estonia really took off. New enterprises badly needed loans, workers needed safe harbours for their paycheques, uneven information flows created opportunities to make fast cash on foreign exchange markets and a wave of privatisations across the former Soviet bloc offered high returns to smart investors. While Soviet-era enterprises were downsizing or shutting their doors completely, and civil servants were counting cents, banking offered unheard of salaries to young men (indeed, they were predominantly men) willing to put in the hours. In 2001, a banker earned nearly triple the average wage. While Tarvi Martens went to work for the state, his cybernetician colleague Jaan Priisalu ended up at Ühispank, and Aivo Adamson, another course mate, landed at Hansapank.⁴⁹

Hansapank, a self-declared ‘bank for the rich’, was by far the most successful of the new banks. In 2001 its annual profits rivalled those of all other Estonian banks combined.⁵⁰ The bank was also technologically innovative: in 1993, it opened up its first electronic banking service, and in 1997 it started offering internet banking, alongside two other Estonian banks. Indrek Neivelt, the bank’s founder, told me in an interview that at the time, i-banking services were not seen as serious business proposals but were permitted according to ‘the liberal principle to let the IT-guys do what they want’.⁵¹ After all, in 1997, only a tiny percentage of the Estonian population even owned computers.

⁴⁵ ‘Riigi intranet ja id kaart. E-valitsus 2000’, AS Helmes ja AS Cybernetica, ERA.5046.1.9214.

⁴⁶ John F. Dooley, *History of Cryptography and Cryptanalysis: Codes, Ciphers, and Their Algorithms* (New York: Springer, 2018), 191–3.

⁴⁷ Arne Ansper et al., ‘Digitaallkirja juurutamine riigiasutustes: strateegiline plaan’, Nov. 2001, 10–11, ERA.5046.1.11144; on the ID card, see 21–22l on the Certification Authority, see 27–30.

⁴⁸ Ain Järv, interview with Raivo Ruusalepp, 11 Oct. 2021, ERA.5446.33529.

⁴⁹ Villu Zirnask, *15 aastat Eesti uut pangandust: Ülesehitusaja saavutused ja õppetunnid* (Tallinn: Eesti Pangaliit, 2002), 7–23, 129–64.

⁵⁰ Zirnask, *15 aastat Eesti uut pangandust*, 123.

⁵¹ Neivelt, interview, ERA.5446.33509.

But things changed quickly. The popularity of personal computers rose rapidly as they became more affordable, and as the state boosted their proliferation with a variety of computer literacy initiatives, such as Tiger's Leap, which outfitted all Estonian schools with computing classes.⁵² Meanwhile, economic crises in Asia and Russia hit Estonian banks hard, leading to bankruptcies and mergers. Over the space of just a few years, Scandinavian banks acquired controlling shares in three Estonian banks: Swedbank became the majority shareholder in Hansapank, SEB in Ühispank, and the Finnish bank Sampo acquired Optiva Pank. Competing for new clients became a more urgent task, and i-banking became an increasingly attractive tool for cutting costs and expanding market share.⁵³

After some highly publicised security breaches in the mid-nineties, performing sensitive transactions online was no longer as straightforward as it used to be. Early internet banking used password cards to authenticate customers – little sheets of paper with one hundred or so password written on them. These got the job done, but they were cumbersome, easy to lose and not particularly secure. In Scandinavia, banks were developing their own two-step authentication systems, but in Estonia, no single bank, not even the ones under Swedish or Finnish ownership, had sufficient R&D budgets for a task of this magnitude.⁵⁴ Even if that were possible, Estonian customers simply could not afford the password generators that were being distributed to customers in Sweden or Finland.⁵⁵ Like the state, the banks faced an authentication problem.

From the start, Martens had invited cryptography specialists from the private sector to provide input to the ID card project. To him, people like Priisalu or Adamson were not competitors but former colleagues, and the only experts in Estonia who knew the task at hand. After a presentation on the new ID card at the former political education centre of the Estonian Communist Party, where the state revealed it was planning to outsource the critical work of the Certification Authority (CA) to the private sector, in order to save costs, the CIOs of Estonian banks quickly proposed collaborating on a joint CA.⁵⁶ Soon enough, the joint effort had expanded to include not just banks but also telecoms and became the *only* CA, essentially a government-supported monopoly.⁵⁷

The 'business case' for supporting the government's project was as follows. The banks would offload a large part of the cost of developing an authentication system for their i-banking services. After an initial investment, the CA would become a for-profit institution, charging a small fee for every certification requested by a corporation (while keeping the service free for private citizens). In a major break with past practice, the banks would be allowed to issue and service ID cards, meaning that citizens picking up their new documents would inevitably end up in the orbit of the banks' tellers and their sales teams. Indeed, to make the proposal even more attractive, the state agreed to subsidise the cost of the ID card by increasing fees on new passports.⁵⁸ Finally, in the long run, increasing the number of i-banking customers would enable banks to close branch offices and reduce brick-and-mortar costs.⁵⁹

The state, meanwhile, was interested in the substantial reduction in costs, and the potential for faster uptake, as people who already used the ID card for their i-banking would be more likely to use it for other public services as well. Critically for both parties, the ID card would be made compulsory to overcome the initial 'chicken-and-egg problem', where companies would not develop services because

⁵² Velmet, 'The Blank Slate E-State'.

⁵³ Neivelt, interview, ERA.5446.33509; Aivo Adamson, interview with the author, 17 Aug. 2021, ERA.5446.33520.

⁵⁴ Margus Arm, interview with Raivo Ruusalepp, 2 Dec. 2021, ERA.5446.33551; Adamson, interview, ERA.5446.33520; Neivelt, interview, ERA.5446.33509; Järv, interview, ERA.5446.33529.

⁵⁵ Kaido Raiend, interview with Raivo Ruusalepp, 8 Dec. 2021, ERA.5446.33554.

⁵⁶ Raiend, interview, ERA.5446.33554; Jaan Priisalu, interview with Raivo Ruusalepp, 20 Oct. 2021, ERA.5446.33538.

⁵⁷ Järv, interview, ERA.5446.33529; Raiend, interview, ERA.5446.33554.

⁵⁸ Järv, interview, ERA.5446.33529.

⁵⁹ Järv, interview, ERA.5446.33529; Raiend, interview, ERA.5446.33554; Arm, interview, ERA.5446.33551.

not enough people had the cards, and people would not get cards because there were not enough services for them.⁶⁰

Things did not work out quite so smoothly. The ID card was launched in 2002, with the first cards delivered to the Estonian president and the first lady at a public ceremony. But in the following four years, although the state issued over one million ID cards, only 50,000 certificates were activated. The predicted flood of public and private services that would be developed for the new digital identity did not materialise. Two years into the life of the card, citizens could do little with it other than file taxes, report residency changes and query five or six registries. The state had all kinds of ambitious ideas for how it could be used – from patient–doctor communication to submitting applications for social benefits – but none had yet been realised.⁶¹ Bank customers preferred to continue using methods they were already familiar with, such as password cards, and the state was slow in developing new online services. Rather than turning a profit, the CA required additional investment.⁶² The card had become a punchline for the media, with one journalist calling it ‘a nearly useless product of banks’ and IT-companies’ lobby that is full of vulnerabilities.⁶³ One popular joke suggested that the only good use for an ID card was scraping ice off a car’s windshield on a cold morning.⁶⁴

To save the project, both the state and the bank–telecom alliance poured money into publicity and the development of new services. The publicity was concentrated into the Look@World Foundation, financed by the same corporations as the CA. The foundation claimed to have trained over 10 per cent of the adult population of Estonia in internet use over two years, with a predominant focus on educating the elderly, blue-collar workers and ethnic minorities. The foundation also tripled the number of public access internet points around the country.⁶⁵ As for services, the Ministry of Economic Affairs directed all other ministries to develop new ways of using the ID card. Among these new services was also a proposal from the Ministry of Justice: to institute online voting as an alternative to paper voting at local elections and, eventually, at national elections.

The governing right-liberal Reform Party (*Reformierakond*) introduced a draft bill on electronic voting in Parliament in the middle of 2001, half a year before the first ID cards were issued to citizens. Märt Rask, the minister of justice, defended the proposal in Parliament by noting that it would increase turnout, bring more young people to the polls and help retain Estonia’s position as leader in ICT but, critically, also labelled e-voting ‘a side-product of the complete application of the digital signature project.’⁶⁶ Indeed, when the bill was passed in early 2002, the National Electoral Commission (NEC), tasked with implementing the law, had very little idea of how the process would actually work. The first analysis commissioned by the Ministry of Justice judged the idea ‘utopian given current technological capabilities’, due to the difficulty of securing users’ personal computers and ensuring that recorded votes could not be altered by malicious actors.⁶⁷ What was clear to the NEC working group, however, was that the precondition to any secure e-voting system would be the new ID card.⁶⁸ The infrastructure was, in fact, so central to the project that the development of the e-voting system was once again entrusted to Tarvi Martens, who had, by then, moved to work for the bank–telecom-sponsored CA.

⁶⁰ Mari Pedak, interview with Raivo Ruusalepp, 4 Oct. 2021, ERA.5446.33526.

⁶¹ Meelis Atonen, Minister of Economic Affairs, ‘Seletuskiri valitsuskabineti nõupidamise otsustuse projekti juurde’, 19 Aug. 2003, ERA.5046.1.11145.

⁶² Adamson, interview, ERA.5446.33520.

⁶³ Mihkel Kärmas, ‘ID-kaardi ohud’, *Eesti Ekspress*, 16 Apr. 2003, ERA.5046.1.11145.

⁶⁴ Pedak, interview, ERA.5446.33526.

⁶⁵ *Koolitusprojekti kokkuvõte* (Tallinn: Vaata Maaailma, 2004), accessed 10 May 2023, https://www.andras.ee/sites/default/files/Vaata_Maaailma_aruanne.pdf.

⁶⁶ Märt Rask, Kohaliku omavalitsuse volikogu valimise seaduse eelnõu (747 SE) esimene lugemine, 13.06.2001, RK.

⁶⁷ Helger Lippmaa and Oleg Mürk, ‘E-valimiste realiseerimisvõimaluse analüüs’, 9 Apr. 2001, <https://www.valimised.ee/sites/default/files/uploads/eh/lipmaamyrk.pdf>.

⁶⁸ Heiki Sibul, interview with the author, 25 Nov. 2021, ERA.5446.33544; Martens, interview, ERA.5446.33521.

Coming up with a system that satisfied both constitutional lawyers and cryptographers took some time.⁶⁹ Conservative Prime Minister Laar had initially envisioned instituting e-voting in the national elections of 2003; in reality, the first online-enabled elections took place in 2005. In 2007, when the first national election with an e-voting option took place, just over 5 per cent of the electorate cast their votes online; by the European elections of 2009, that had risen to 15 per cent. Combined with the growing popularity of other e-services, like tax filing, e-voting had become popular enough to form a core part of Estonia's new mythology as an innovative digital republic.

One version of the e-voting story depicts it as the brainchild of Laar's government, known for its love of technology and the exuberant energy of its 'chief information officer', Linnar Viik, who tied Estonia's various e-services together into an ideology of an 'information society'. In Viik's view, transforming the Estonian public sector into an online-first ecosystem would prevent the emergence of Soviet-style corruption, educate a critically minded citizenry and leap-frog Estonia ahead of Western welfare states, without requiring similarly generous tax-and-spend policies. Here, e-voting was just one component alongside other e-democracy initiatives. These included e-government, a paperless system of holding cabinet meetings that was more of a PR trick than a substantial innovation, and a participatory democracy portal called Today I Decide (Täna Otsustan Mina, TOM), where citizens could propose new legislation, with the government required to provide feedback on the most upvoted proposals.⁷⁰ There is some truth to this story, which had been elaborated since the state had first started its programme of computerising Estonian schools with Tiger's Leap in 1997.⁷¹ But taking an infrastructural view situates e-voting as part of a larger story of civil service reform and the capture of public infrastructure by private actors. Here, e-voting becomes part of a series of initiatives designed to save an ambitious idea – of using the power of the state to lure Estonians to switch to online banking – from an unexpectedly underwhelming execution. It becomes one chapter in a story of engineers with grandiose plans improvising when faced with indifferent politicians. It becomes a problem invented for a pre-existing solution. What it does not do is reinvent democracy.

The E-voting Service

The infrastructure of the e-voting system shaped the discourse over its legitimacy long after implementation. When legislation on e-voting was first introduced in 2002, it encountered principled but light opposition from the parliamentary opposition – hyper-nationalist, left-of-centre and agrarian parties, who opposed it on the grounds of insufficient secrecy (citizens would not be voting in booths, but anywhere with an access to a PC) and security (following a vote from the voter's computer to the 'ballot box' would be complicated).⁷² Citing similar concerns, the Estonian president, Arnold Rüütel, sent the draft law to the Supreme Court for constitutional review, where it received a positive ruling.⁷³ After the initial controversy had subsided, the legitimacy of e-voting was rarely contested. Still, two notable exceptions are worth discussing.

The first series of critiques came from local hackers, Paavo Pihelgas and Märt Pöder. In 2011, Pihelgas, in an episode of the popular investigative programme *Pealtnägija*, demonstrated how a virus could prevent the voting software from sending a vote to the NEC server, without leaving any trace of

⁶⁹For an overview of the various legal challenges regarding e-voting, see Ülle Madise, 'Interneti teel hääletamise õiguslikke ja poliitilisi aspekte', *Juridica: Tartu Ülikooli õigusteaduskonna ajakiri* 10 (2006): 663–72.

⁷⁰On Today I Decide, see Andrew Glencross, 'E-Participation in the Legislative Process Lessons from Estonia for Enhancing Democratic Empowerment', *JeDEM – eJournal of eDemocracy and Open Government* 1, no. 1 (4 Sept. 2009): 21–9, <https://doi.org/10.29379/jedem.v1i1.1>. On e-government, see Riina Einberg, interview with the author, 4 Aug. 2021, ERA.5446.33503.

⁷¹Velmet, 'The Blank Slate E-State'. See also Mart Laar, informational session at the Estonian parliament, 17 Jan. 2002, RK.

⁷²See for instance Tiit Käbin and Arvo Sirendi, Kohaliku omavalitsuse volikogu valimise seaduse eelnõu (747 SE) esimene lugemine, 13 June 2001, RK.

⁷³Rüütel sai e-valimistega lüüa, *ERR Uudised*, 1 Sept. 2005, <https://www.err.ee/435,363/ruutel-sai-e-valimistega-luua>.

this for the user.⁷⁴ Põder, a long-time internet freedom activist and member of the local Pirate Party, demonstrated in 2015 that it was possible to cast a spoiled ballot for a fictional candidate 'Tarmo Jüristostein', a theoretical impossibility, since the e-voting app only allowed voting for candidates on electoral lists.⁷⁵ In the following years, Põder continued to draw attention to what he termed 'the fundamental unverifiability of the e-vote'.⁷⁶ The NEC responded to these critiques by adding a verification mode to the e-voting app, allowing voters to check whether their vote had been recorded in the NEC server as it was cast. A second update, in 2017, added a data auditor to the vote tabulation process, which could 'verify the integrity of the voting result without breaking ballot secrecy'.⁷⁷ The Ministry of Economic Affairs even appointed Põder to a working group to review e-voting procedures in 2019 – although the group's recommendations did not lead to substantial modifications.⁷⁸

A more substantial critique was proposed by a team of American researchers, who observed e-voting at the 2013 local elections at the invitation of the Centre Party (*Keskerakond*), which had opposed e-voting since its institution in 2005. The highly credentialed observers issued a scathing report, in which they concluded that the system had 'serious design weaknesses that are exacerbated by weak operational management, [...] problems [that] stem from fundamental architectural problems that cannot be resolved with quick fixes or interim steps' and recommended that 'to maintain the integrity of the Estonian electoral process, use of the Estonian i-voting system should be immediately discontinued'.⁷⁹ The critique got a lot of play in Estonian media but was widely rejected by local security experts and the NEC. A central claim of the critique was that the system could not guarantee client-side security – users' computers could be systematically infected by malicious state-level actors, and election results could be irreversibly altered.⁸⁰ NEC experts responded that achieving full operational security with e-voting was impossible, and the user would always hold some responsibility for maintaining computer hygiene. Still, the digital signature created a level of security *comparable to paper voting*, that, in the view of election officials, set the Estonian e-voting system apart from its international counterparts and more than sufficiently answered the critiques of American observers.⁸¹

The American report did not limit its critique to issues of user security. The researchers warned that the system could also be attacked on the server side, and that their observation of local elections had revealed major lapses in operational security on the part of the NEC.⁸² Some of their critiques were more convincing than others.⁸³ The point here, however, is not to litigate the validity of e-voting but rather to note that the Estonian authorities' response turned on the physical and rhetorical qualities of its unique digital ID system. It allowed Estonian cryptographers to address specific critiques regarding client-end security, but equally importantly, the digital ID became a kind of cultural totem that authorities used to distinguish the Estonian system from other electronic voting systems, whether those were internet-based or not. Indeed, Switzerland, Norway and the United States did not have

⁷⁴ 'Tudeng tahab e-valimiste tühistamist', *ERR Uudised*, 9 Mar. 2011, <https://www.err.ee/374,566/tudeng-tahab-e-valimiste-tulemuste-tuhistamist>.

⁷⁵ Mattias Tammet, 'Ainuke e-hääle rikkujä: Eestis ei julgeta e-hääletamist kritiseerida', *Õhtuleht*, 3 Mar. 2015.

⁷⁶ Märt Põder, 'Vaadeldamatu e-hääletus pole usaldusväärne', *Postimees*, 29 Mar. 2015.

⁷⁷ Sven Heiberg et al., 'Improving the Verifiability of the Estonian Internet Voting Scheme', in *Electronic Voting*, ed. Robert Krimmer et al., Lecture Notes in Computer Science (Cham: Springer International Publishing, 2017), 92–107, https://doi.org/10.1007/978-3-319-52,240-1_6.

⁷⁸ 'E-valimiste turvalisuse tööühma koondaruanne', 12 Dec. 2019, Majandus- ja Kommunikatsiooniministeerium, <https://mkm.ee/media/8583/download>.

⁷⁹ Springall et al., 'Security Analysis of the Estonian Internet Voting System'.

⁸⁰ Springall et al., 'Security Analysis of the Estonian Internet Voting System', 8–9.

⁸¹ Mirko Ojakivi, 'Eesti turvaekspertide kinnitused pole e-valimised manipuleeritavad', *ERR Uudised*, 13 May 2014, <https://www.err.ee/512909/eesti-turvaekspertide-kinnitused-pole-e-valimised-manipuleeritavad>.

⁸² Springall et al., 'Security Analysis of the Estonian Internet Voting System', 4–5.

⁸³ For a response to Springall's critique, see Mirko Ojakivi, 'Eesti turvaekspertide kinnitused pole e-valimised manipuleeritavad', *ERR Uudised*, 13 May 2014, <https://www.err.ee/512909/eesti-turvaekspertide-kinnitused-pole-e-valimised-manipuleeritavad>.

a compulsory, encrypted system of authentication like the Estonian ID card. Foreign experts could therefore be credibly accused of transposing legitimate problems with their own systems to Estonia, where the analogies did not apply. In the words of the security expert Anto Veldre, ‘the service offered by the Certification Authority is the “magic stuff” that allows any bank, tax board or small enterprise to verify a person’s identity online.’⁸⁴

Alongside technological critiques (that e-voting is not secure enough) and philosophical critiques (that it does not approximate conditions of physical voting well enough), various actors have, of course, levied political critiques at the programme, suggesting that electronic voting distorts the democratic playing field in favour of certain parties. In the early days of the programme, these accusations most commonly came from the oppositional Centre Party, whose voters tended to skew older and poorer and were therefore less likely to have access to the internet.⁸⁵ In recent years, buoyed by Donald Trump’s rejection of election results in the United States, the far-right Conservative People’s Party has regularly challenged the legitimacy of e-votes, suggesting that these have been manipulated by the liberal bloc.⁸⁶ While such arguments may be useful for mobilising core voters and explaining away election losses, they have not found purchase with courts. Independent analyses of e-voting have shown that although liberal bloc voters were more likely to vote online, there is no evidence that the ability to vote online actually tilted the playing field. In other words, the availability of e-voting did not increase turnout among voters of specific parties; it simply made younger, wealthier and more technologically savvy voters – who tended to vote liberal – switch from paper voting to e-voting.⁸⁷

Conclusion

The e-voting programme was but one of several digitisation initiatives pursued by the Estonian state. Some were more successful than others. Efforts to develop digital democracy often faltered on poor design choices, haphazard implementation and a lack of political support. The Laar government launched two other ventures alongside e-voting: e-government and a participatory democracy forum called Today I Decide (Täna Otsustan Mina). The first can be described as a glorified PR project. Launched at a moment’s notice in 2000, even Linnar Viik, the programme’s godfather, had a hard time describing what e-government was supposed to do. Ultimately, it amounted to little more than an online system for managing the paperwork of government sessions, so ministers could share and approve bills on their laptops.⁸⁸ Today I Decide allowed citizens to propose, discuss and vote on new legislative ideas, which then required a response from relevant officials. The crude online platform was quickly overtaken by trolls, and civil servants had to respond to what they perceived as ludicrous proposals (such as drug legalisation) with no additional resources. In other words, the programme was unpopular among all constituents, and by 2004 it was already considered a failure.⁸⁹ Programmes focused on digital services fared better, particularly if they could be financed from EU structural funds and had buy-in from private actors. Still, many initiatives, such as a government e-health platform developed from 2005 to 2012, were plagued by cost overruns and conflicts between interested

⁸⁴ Anto Veldre, ‘E-valimised on (liiga) turvalised’, *Riigi Infosüsteemi Ameti blogi*, 14 May 2014, <https://blog.ria.ee/e-valimised-on-liiga-turvalised/>.

⁸⁵ Liis Velsker and Nele-Mai Olup, ‘Ülevaade: Keskerakonna võitlused e-valimiste vastu’, *Postimees*, 5 Sept. 2017, <https://www.postimees.ee/4233855/ulevaade-keskerakonna-voitlused-e-valimiste-vastu>; ‘Tallinn tahab tunnistada e-hääletuse kehtetuks’, *Pealinn*, 5 June 2011.

⁸⁶ Martin Helme, ‘Kui e-valimised aktiivsus oli suur, on küsitav, kas need olid pärisvalijad’, *Postimees*, 5 March 2023, <https://www.postimees.ee/7725663/martin-helme-kui-e-valimiste-aktiivsus-oli-suur-on-see-kusitav-kas-need-olid-parisvalijad>.

⁸⁷ Solvak and Vassil, *E-Voting in Estonia*, 142–62.

⁸⁸ ‘Vabariigi Istungite infosüsteemi analüüs, koostajaks AS MicroLink süsteemid’, 1 June 2001, ERA.5046.1.11139; see also Linnar Viik, interview with the author, 18 June 2021, ERA.5446.33501.

⁸⁹ ‘Eesti e-riigi kuulsamaid lipulaevu kukkus läbi’, *Postimees*, 19 June 2004; Solvak and Vassil, *E-Voting in Estonia*, 142–62. See also Maarja Toots, ‘Why E-Participation Systems Fail: The Case of Estonia’s Osale.Ee’, *Government Information Quarterly* 36, no. 3 (1 July 2019): 546–59, <https://doi.org/10.1016/j.giq.2019.02.002>.

parties.⁹⁰ The particular confluence of public and private interests, mediated by the network of cyberneticians and unhampered by legacy systems that made digital ID and e-voting possible, only came around once a century.

International trials of e-voting in Norway, Switzerland, Canada and elsewhere have often resulted in negative assessments or decisions to limit e-voting to 'lower-stakes' situations, such as municipal elections or local referenda. In Norway, the opposition of right-wing parties over issues of trust led to the discontinuation of e-voting trials after a change in government in 2013.⁹¹ In Switzerland, where e-voting is permitted in certain cantons for citizens living abroad, implementation has been slowed by ongoing security concerns and the need to develop technical solutions that respond to these (such as return codes that verify that a vote has been recorded accurately).⁹² In the Netherlands, enthusiasm for e-voting dimmed considerably after activists groups pointed out various ways in which internet voting compromised the secrecy of the vote.⁹³ Few other former Soviet bloc countries have pursued digitalisation of the public sector to the same degree as Estonia. Officials in both Latvia and Lithuania have discussed e-voting but rejected it on the grounds that the security of the process and the secrecy of the vote cannot be sufficiently ensured.⁹⁴ Analysts in Ukraine have noted that the minimal preconditions for considering various e-democracy projects – a secure authentication method akin to the ID card and centralised voter registries – were only created in the early 2020s, and thus any serious consideration of e-voting is still years away.⁹⁵ Finally, as a dark reminder that e-voting is not the same as democracy, using the coronavirus pandemic as an excuse, Vladimir Putin's Russia allowed e-voting in the constitutional referendum of 2020, which removed term limits from the presidency, as well as the 2021 State Duma elections and elections in Ukraine's occupied regions of Donetsk and Luhansk in 2022.⁹⁶

While there are admittedly few comparative studies on e-voting, two central reasons for limiting its expansion seem to have been political controversy and the lack of an infrastructural base.⁹⁷ While other socialist states, too, benefited from expertise in cybernetics, Estonia's position on the Baltic made it unique. Nordic banks and telecoms motivated the state to pursue the ID card project, and long-standing ties to the Nordics gave Estonian cyberneticians cross-sectoral expertise that engineers elsewhere lacked. Of course, an authoritarian regime like Putin's Russia could simply ignore concerns over security and confidentiality and pursue its political agenda. The Estonian case was successful precisely since it was pursued not as a political project but rather as part of a public–private infrastructure project led by civil servants, banks and telecoms. Indeed, *political* interest in the programme surged years after it had been implemented, once opposition parties began to suspect it might negatively affect their electoral performance. As for infrastructure, state officials and IT engineers, who

⁹⁰See the Ministry of Social Affairs records ERA.5276.1.1153 through ERA.5276.1.1159 on the development issues. See also Agu Kivimägi, interview with the author, 10 Aug. 2021, ERA.5446.33506; Madis Tiik, interview with the author, 12 Oct. 2021, ERA.5446.33530.

⁹¹Jo Saglie and Signe Bock Seggaard, 'Internet Voting and the Secret Ballot in Norway: Principles and Popular Understandings', *Journal of Elections, Public Opinion and Parties* 26, no. 2 (2016): 155–69, <https://doi.org/10.1080/17457289.2016.1145687>.

⁹²Ardita Driza-Maurer et al., *E-Voting for Swiss Abroad: A Joint Project between the Confederation and the Cantons* (Bonn: Gesellschaft für Informatik e.V., 2012), <http://dl.gi.de/handle/20.500.12116/18211>.

⁹³Leontine Loeber, 'The E-Voting Readiness Index and the Netherlands', *Proceedings E-Vote-ID 2018*, n.d., 179–93.

⁹⁴Jānis Kincis, 'Little Chance of E-voting in Latvian Elections for the Foreseeable Future', *Latvian Public Broadcasting*, 6 Mar. 2023, <https://eng.lsm.lv/article/politics/politics/little-chance-of-e-voting-in-latvian-elections-for-foreseeable-future.a499509/>.

⁹⁵Oksana Onyshchuk et al., 'Comparative Analysis of E-Democracy Implementation in Ukraine and Switzerland', 2020, CEUR-WS 2654: 629–628.

⁹⁶Konstantin Skorkin, 'A New Potemkin Vote in Occupied Ukraine', *Carnegie Endowment for International Peace*, 12 June 2023, <https://carnegieendowment.org/politika/89944>; 'Russia to Allow Remote Voting for Putin's Constitutional Amendments', *Moscow Times*, 13 May 2020, <https://www.themoscowtimes.com/2020/05/13/attend-online-talks-on-architecture-in-film-a70266>.

⁹⁷Krimmer, Triessnig and Volkamer, 'The Development of Remote E-Voting Around the World'; Ehin et al., 'Internet Voting in Estonia 2005–2019'.

had bought into the system from the beginning, had anticipated some criticisms and could deflect others by referring back to Estonia's 'special' ID card foundation.

Ideologically, the post-Cold War Estonian state appears deeply contradictory, providing material for narratives of exceptional innovation and depressing typicality alike. Those looking for evidence of Estonian uniqueness can point to its commitment to building a digital democracy, in the form of initiatives such as e-voting or participatory platforms. Those who consider Estonia a textbook case of the neoliberal turn note that the most successful digital initiatives have been vehicles for leveraging state capacity to the service of private enterprises, and that ideologically, the digital republic has been articulated as an alternative to the administratively bulky welfare state. The popularity and longevity of both these narratives are primarily a testament to the salesmen of the digital republic, who have stitched together coherent narratives of contingent, unexpected and haphazard developments, in order to sell the e-state to domestic political and international business audiences.

There is some truth to both these tales, of course. Reconciling them, though, requires an infrastructural approach. Investigating the emergence of the sociotechnical systems that underpin the digital state reveals a story that is much more local, characterised by negotiation and compromise and populated by a very different set of actors than in either the triumphalist or tragic stories. The story of the digital republic is a story of unintended consequences, without a straightforward ideological trajectory, because the actors involved had no singular goal in sight. Much like the story of Latin American 'mixed economies', the infrastructure of the digital state generated resources for a host of different purposes.⁹⁸ Some of these goals grew out of Soviet administrative structures and the Institute of Cybernetics, others had to do with European integration and others still with business interests piggybacking off public infrastructure. If Stephen Collier suggested that many of the neoliberal reforms in post-Soviet Russia were constrained by existing socialist infrastructure in the city of Belaya Kalitva, then my analysis suggests that a version of neoliberalism was both *made possible as well as constrained* by the assemblage of infrastructures whose roots lay, among others, in the Soviet past. Rather than being invented by transnational companies, national politicians or intellectuals, the 'neoliberal' digital republic was built around the infrastructure of a universal, compulsory digital ID. The ID card was imagined by Soviet cyberneticians, sponsored by banks and telecoms who offloaded their own R&D work onto the state, but it ultimately facilitated the construction of services that both meaningfully simplified the exercise of democratic power and generated a discourse that emphasised the efficiency of state bureaucracies over all other concerns. The story of the digital state is one of infrastructure that was repurposed and rethought over time – and can be repurposed and rethought today.

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⁹⁸ Amy C. Offner, *Sorting Out the Mixed Economy: The Rise and Fall of Welfare and Developmental States in the Americas* (Princeton: Princeton University Press, 2021).

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