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Estonia's digital transformation:
Mission mystique and the hiding hand

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Abstract
Estonia's transition to free-market capitalism and liberal democracy is marked by two distinct achievements: first, its economic success in terms of GDP, exports and FDI growth – all three have been best of class among the former Soviet economies; and second, it has been perhaps even more successful in digitally transforming its public sector, an achievement that is recognised globally as exemplary. It would be easy to assume that in such a small country these achievements spring from a common biotope of political ideas and actors. Instead, the digital transformation has relatively little to do with the free-market principles (Adam Smith's famed 'invisible hand') that were behind its radical economic reforms. We argue that in adopting digital technology in the public sector, Estonia followed an entirely different principle of policymaking, best described as Hirschman's principle of the 'hiding hand'. This amounts to policymakers pushing visionary changes without anticipating all the challenges and risks involved upfront, an approach that sometimes results in unexpected learning, creativity and – in this case – success. The naiveté and enthusiasm of the hiding hand that propelled the initial 'crazy ideas' of the early 1990s became ingrained in Estonia's digital policymaking culture, and created and relied on multiple highly cooperative, overlapping networks across public-private boundaries. The success, expressed mostly in universal public digital infrastructure and mandatory e-identification, created a 'mission mystique' that originated in, and is sustained by, public-private networks underlying several public organisations through multiple coalition governments over two decades. Perhaps paradoxically, Estonia's success in e-government relied on these networks and their governance, as well as design principles, *not* being institutionalised and formalised. Herein lies the most significant challenge Estonia faces now: whether the foundations of past success – mission mystique – can deliver the next evolution in digital government and help create a more inclusive society.

1. A digital success story in a nutshell

In 2017, *The New Yorker* published an article titled 'Estonia, the digital republic' (Heller, 2017) and subtitled, 'Its government is virtual, borderless, blockchained and secure. Has this tiny post-Soviet nation found the way of the future?'. This summarises the buzz around Estonia's digital transformation: from the outside, at least, it is seen as a major success and has been lauded in mainstream media such as the *Financial Times*, *New York Times* and *Forbes* (Crouch 2015; Scott 2014; Gaskell 2017). In these, Estonia's success in digital government is frequently described in parallel with its thriving ICT industry, best exemplified by Skype, which originated and is still primarily based in Estonia, and which was subsequently acquired by Microsoft.

The Estonian e-government infrastructure and its success rest on two main pillars, both introduced in 2001, which essentially create a digital state and digital citizens: the data infrastructure x-road and a compulsory national digital ID (Kalvet 2012; Kalvet and Aaviksoo 2008; Margetts and Naumann 2016). X-road is an interoperability platform for existing decentralised databases and a data exchange layer that can be used by public and private sector actors. It is independent of platforms and architectures, and provides secure interoperability for data exchanges and identification of trusted actors in digital service delivery. The digital ID makes it possible for citizens to be identified digitally and to use digital signatures. Together, x-road and the digital ID make it possible to digitally sign any contract, access essentially any public service, order prescriptions, file taxes, vote and so forth. More than 2,300 public and private services use x-road, and the digital signature has been used almost 350 million times by Estonia's population of 1.3 million. The digital ID penetration is close to 100%; 30% of votes are cast digitally (in both local and national elections); almost all personal income tax declarations and medical prescriptions are done online, and most medical records held by hospital and family doctors are accessible online. The Estonian government claims that its e-government infrastructure has led to annual savings of about 2% of GDP and more than 800 years in working time for the public and private sectors.[1]

According to the EU's Digital Economy and Society Index (DESI), in 2017 Estonia was the leading nation in Europe in digital public services, although in 2018 it dropped to second place. However, in most other e-government rankings Estonia's digital success is less evident. In DESI's overall ranking, Estonia is in ninth position for 2018 and, according to the UN's 2018 e-government survey it is ranked only 16th globally[2]. This cognitive dissonance – high praise and leadership position in global news outlets versus relatively middling rankings in overall digital transformation indexes[3] – reflects the nature of Estonia's digital success: Estonia is ranked high for its digital public service *infrastructure*, which is universally available and mandatory, and an integral backbone of public service delivery. Estonia's digital success, however, is *not* about other digital offerings such as digital democracy, citizen engagement or digitally transforming public services such as the welfare state.

The specific nature of Estonia's digital achievement and at the same time disconnect between technological infrastructure and degree of digital penetration is often overlooked in international coverage. Domestically it has become a crucial political and policy issue over the past few years. For instance, referring to the above-mentioned less-than-stellar rankings in global indexes, Kaja Kallas,

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[1] E-Estonia facts, https://e-estonia.com/wp-content/uploads/updated-facts-estonia.pdf.
[2] See https://ec.europa.eu/digital-single-market/en/desi and https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2018 respectively.
[3] Drechsler 2018a offers an excellent discussion on the hype around Estonia's digital success.

who since 2018 has headed the Reform Party, one of the largest and most popular parties (for 15 years, until 2016 when it was forced into opposition, it led various coalition governments), has argued that much of the e-government infrastructure is morally outdated and has called for fundamental reforms in Estonian e-government (Kallas 2018). With the decision to focus its digital development on x-road only, Estonia has effectively created its own legacy system – a move that the initial thinkers wanted to avoid. This realisation comes in the middle of increasing domestic criticism of the so-called e-residency programme, launched in 2014 and highly lauded in the international media, which essentially opens up some of the x-road and digital ID-based services globally[4] (see Tammpuu and Masso 2018)

It is important to note that Estonia's success is the product of a national approach rather than a single policy or even a bundle of programmes. Indeed, Estonia's digital initiative does not arise from a documented foundational policy or strategy, or even documented discussion and debate. *Principles of Estonian Information Policy*, which was approved by the Estonian parliament in 1998 and which is seen as the critical scene-setter for digital transformation in the 1990s (Kalvet 2007), does not mention any of the fundamental principles or developments that took place just a few years later. It can therefore be argued that the Estonian digital transformation is characterised by 'development-driven strategies' rather than by 'strategy-driven development'[5] (Kalvet 2007, 11).

Furthermore, unlike other countries that have set out on the digital transformation journey, Estonia has never had a central office for digital transformation, such as the UK's Government Digital Service (GDS), despite the fact that such a central agency was initially envisioned to manage (among other things) vital public registries (*Estonia's Roadmap to the Information Society* 1994). Nor is there a formally designated and empowered state official for digital enablement: the current government chief information officer position exists only in English translation and only informally.[6]

Estonia's digital transformation has been an extended and on-going process over three decades, starting in the early 1990s, when Estonia regained its independence, and continuing to the present day. It was informed by successive debates and developments, and multiple policy initiatives. Much of this process has been ad hoc and informal. For example, many strategic policy documents for digital transformation have followed the rhythms of European (structural) funding periods rather than responding to domestic challenges and planning processes.[7] Similarly, various overlapping and mostly self-managed public-private networks have provided the informal dynamic capacity and capability for change, few of which have been institutionalised or formalised.

However, a fundamental constant in Estonia's digital transformation has been widespread cross-party support for the digital agenda. Starting with the first independent government in 1992, ICT

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[4] E-residency programme homepage and live dashboard can be found here: https://e-resident.gov.ee. As of August 2018, Estonia has more than 40,000 e-residents. As the main service e-residents can currently use is setting up a company, this has had unintended consequences as it has drawn the attention of money laundering regulators in some countries.

[5] Thus, for instance, the data exchange layer called 'x-road', introduced in 2001 and fundamental to Estonian e-government, is not mentioned in the 1998 strategy document at all, either by name or principle. A subsequent 2004 strategy document, *Basics of Information Policy*, mentions it once; a 2006 follow-up strategy, *Development Plan for Information Society 2013*, discusses x-road twice; and the current strategy, *Development Plan for Information Society 2020*, adopted in 2013, mentions it eight times – even though the x-road has not changed significantly since 2001.

[6] The position is formally called Deputy Secretary-General for Communications and State Information Systems and is part of the typical management structure in Estonian ministries and not a standalone office. See https://www.mkm.ee/en/ministry-contact/management.

[7] Starting with the 2004 strategy, the timings of adoptions of the strategies reflect EU structural funding periods (2004-2006; 2006-2013; 2014-2020).

development in society has been seen as delivering competitive advantage, as a symbol for leaving the Soviet past behind, and as an indicator of Estonian society and economy opening up towards the West. Digital transformation as a vision was part of a broader political consensus at the time that included the agreement to join the European Union and NATO. To this day, the digital agenda enjoys widespread political support and has become part of Estonia's official image and branding, as evidenced by the e-Estonia showroom,[8] which is almost a mandatory stop of any official state visit.

In the following sections we review past events and decisions to untangle the essential elements and distinctive features of Estonia's digital government success. Perhaps the critical question is whether the success factors and drivers of the past decades can be relied on to deliver the next generation of digital transformation policies in Estonia.

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[8] See https://e-estonia.com.

2. Contexts, challenges, agents

2.1. History and the hiding hand

In 1990 Estonian state-owned electronics companies employed 26,000 people. Today that figure is lower, despite the fact that over the past 20 years electronics has been a principal and highly successful export (Tamkivi 2017; Ubar 1993). Yet the transformation of Estonian electronics from a Soviet legacy industry into an integral part of Scandinavia's global value chains had almost nothing to do with Estonia's digital government. So why and how did digital government emerge as a paradigm next to, and competing with, electronics and industry in general? In other words, why did digital transformation not follow the path of the 'invisible hand' of free-market reforms, a set of ideas so dominant in Estonia from the 1990s onward?

Two crucial political circumstances in the 1990s provide the answer. First, after regaining independence in 1991, the first free elections in Estonia brought to power political forces that were intent on cutting ties to Soviet legacies in all aspects of society. Some developments were inevitable: as the Soviet planning system collapsed, so did export markets to the east and companies needed to transform themselves into privately owned entities relying on domestic (and mostly Western) markets (Reinert and Kattel 2004). Others came from political will, such as the desire to consciously embrace recent Western technologies, products and services rather than attempting to upgrade inherited Soviet technical, production and service systems (Drechsler 1995). This resulted, for instance, in changes to the funding and governance of R&D; the privatisation of state-owned companies; and transformation of the finance sector – all following a guiding political principle of transition by replacement (Kattel 2012). This proved particularly crucial for ICT, because in both private and public sectors it encouraged a focus on new IT solutions as opposed to large-scale, centralised legacy systems. This also excluded Western legacy systems available in the form of development aid.

Transition as replacement was complemented with a political idea underpinned by the same ideological principle: namely, to 'leapfrog' the West's technology. Here the success of Finland and Nokia became one of the guiding political reference points: 'What is our Nokia?' asked Lennart Meri, Estonia's first president after Estonia regained independence in 1991, a question that has remained a popular catchphrase. As Estonia seemed to lack the political will and economic capacity to build its own significant industry, the focus turned to developing what might be labelled as a 'general-purpose technology'. In other words, rather than developing specific IT and electronics industries, the political focus was on developing IT as a general-purpose socio-economic skill to be shared by as many citizens as possible.

These twin ideas laid the groundwork for three critical features of Estonia's digital transformation that are still dominant today:
1) future-oriented and almost utopian solutions – the realm of 'crazy ideas', as expressed by Mart Laar, Prime Minister from 1992-1994 and 1999-2002;
2) public digital architecture that is universal in nature; and
3) decentralised digital agendas (including databases) of line ministries.

Thus, in its purest form, Estonia's digital transformation can be seen as a strategy to leapfrog rather than just catch up with the West (Burlamaqui and Kattel 2016). In this narrative, widely shared among the emerging policy networks in the early 1990s, the five decades of Soviet occupation are seen as a lost time and there is a glorification of what one might call the first republic, which lasted from 1918

until 1940. Following its independence, Estonia not only re-issued *kroon*, its currency from the interwar period, but also based its new constitution on its previous constitutions of 1920 and 1938, indicating its reliance on traditional values. The digital initiative provided another component to further the new republic's double ambition: to be the state and the society that it was in the interwar period *and* to leapfrog the West in development.

However, two significant differences exist between Estonia in the 1930s and the 1990s: the ethnic composition of its society and its economic structure. In 1934, 88% of inhabitants were Estonian and this increased to 97% after mass emigration during WWII. In subsequent decades this trend reversed, as people, mostly ethnic Russians and Ukrainians, were encouraged by the Soviet government to move to Estonia from the Soviet Union. By 1989 native Estonians dropped to as low as 62%; in north-eastern Estonia, the percentage of Estonians decreased to 13% in 1989 (from 65% in 1934) (Estonian Statistics). These shifts in the population were associated with rapid industrialisation, particularly in north-eastern Estonia, which created a long-standing high demand for labour (Rajasalu 2002). Plans for even more investment into resource-intensive heavy industry and mining – and fears of new waves of immigration – played a crucial role in galvanising the popular independence movement in the late 1980s around environmental protection issues (Manning 2007).

This confluence of industrialisation with ethnic tensions explains why Estonia, despite being one of the most economically and technologically advanced countries within the Soviet Union, chose not to upgrade the inherited economy and instead sought to do something completely different. As an emerging general-purpose technology, ICT offered an almost perfect solution, particularly given the availability of R&D skills in this sector. 'The digital' thus came to express Estonia's – or more precisely, its elite's – ambitions and explains why, to this day, the 'digital elite', with some rare exceptions, is almost all ethnically Estonian.

The role of 'crazy ideas' was initially also part of Estonia's economic policy. For example, Estonia introduced a relatively unique currency board to manage its currency and a flat income tax rate (both rare in Western or other economies). The first prime minister after independence was regained, Mart Laar, was openly radically neoliberal, citing Milton Friedman and counting Margaret Thatcher among his friends. Also, the success of these reforms brought international recognition and gave Laar and others confidence to pursue further radical ideas. This contributed largely to Estonia's rise as the extreme and successful reformer in the eyes of the international community – and as the main disciple of Adam Smith's famed 'invisible hand'-led economic policies whereby free markets provide the best economic outcomes. The implementation of 'invisible hand'-enthused policies by the first Laar government in 1992-1994 relied upon the enthusiasm of amateur politicians, who drew at least part of their risk-taking courage from their naiveté, well described by Albert Hirschman (1967). His principle of the 'hiding hand' notes that policymakers sometimes take on tasks without realising the risks involved, and that this may result in unexpected creativity and success. As Hirschman argues, the hiding hand works through ignorance of ignorance (1967). Laar himself is first to agree: 'I was 32, I was young and crazy, so I didn't know what is possible and what's not, so I did impossible things.' (Laar 2010). In digital government, this did not lead to free market-based solutions, but rather to visionary policies that relied on charismatic leadership, small, tight networks, and the constant renewal of both leadership and networks.

2.2. External influences and skills

The academic elite played a vital role in the early genesis of Estonia's digital transformation. Mart Laar recalls how one of the first things that came across his desk as prime minister was a memo by Raimund Ubar, professor of computer engineering at Tallinn University of Technology, titled 'Targeted programme for Estonian electronics and computer technology' (Ubar 1993). The purpose of the memo was to convince the government to establish an R&D program in electronics and computer engineering in order to upgrade Estonian industry. While Ubar's memo focused on industry and applied research, what seems to have impressed Laar was Ubar's insistence on avoiding the legacy trap he had observed in Western countries and encouraging a policy of investment in future-oriented emerging technologies rather than in legacy technology. Laar recalls:

> *Ubar wrote that it is not sensible to overreact and start immediately buying things. He was the first person who told us not to buy anything old.* (Mart Laar interview)

Budgetary means were scarce and capacity to develop centralised IT systems was low, so the avoidance of this legacy trap allowed the policymakers to eschew large-scale investments into ICT. Later, during Laar's second government (1999-2002) this became the unspoken *principle of frugality*: rather than buying large-scale solutions from established vendors, government departments and agencies were encouraged to find open-source solutions. This also forced departments and agencies to develop their own digital agendas.

In the initial decision-making processes, academics played a vital role as part of the first formal advisory body on ICT, the Informatics Council, established in 1990. The focus on cybersecurity, a prominent feature of the x-road, can be traced back to the Informatics Council, as many of its members had a connection with the Estonian Academy of Sciences' Institute of Cybernetics.[9] From this institute, Cybernetica AS, one of the companies that delivers many of the public digital solutions, including x-road, was founded. Academics were also the first to establish actual Internet connections with the West through networks with Swedish colleagues (Högselius 2005).

Proximity to Scandinavia played an essential role in building the ICT landscape in Estonia. In 1991 the Estonian government reorganised the Ministry of Communications into two state-owned companies, Eesti Telekom and Eesti Post, decoupled from Soviet telecommunication networks and created a mobile joint-venture with Swedish and Finnish counterparts called Eesti Mobiiltelefon (Högselius 2005: 81). This company initially used the NMT and not the GSM standard for mobile technology (as did the Nordic countries at the time). Eesti Telekom, in turn, acquired the monopoly rights for Estonia's fixed telephony until 2000, but the concession agreement left out mobile and data communications – and this proved critical in the years to come (ibid: 83). Another joint venture between Estonia and the two Nordic countries, Eesti Telefon, was an important early investor into Estonia's digital infrastructure modernisation (ibid: 91).

The R&D programme in electronics proposed by Ubar to Laar never materialised, but ICT gained importance as a cross-party policy goal throughout Laar's first administration. During Laar's second administration (1999-2002) many of the critical elements of Estonia's ICT policy coalesced into a more or less coherent framework and were quickly translated into swift and radical actions. Key to this development was Linnar Viik, a serial entrepreneur and later founder of the e-Government

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[9] For a detailed discussion of the vital importance of the Institute of Cybernetics, established in 1960, and the role of its R&D capabilities in the evolution of the Estonian ICT sector, including its involvement in 'Soviet Arpanet', see Högselius 2005.

academy, as the ICT advisor to the prime minister. Viik became an influential advisor with a wide-reaching portfolio, more important and powerful than many of the ministers (Mart Laar interview).

As the digital experiment – and the modern republic – matured, political leadership in ICT became less about ideas and policies and more about recruiting talented IT people to work for the government. This was much helped by the fact that the Estonian civil service is designed as an open system: almost all positions can be filled through open, competitive calls. Thus, for instance, Taavi Kotka, former CEO of Nortal, one of the largest domestic ICT companies, was hired as government 'chief information officer' in 2013. Lack of legal and public barriers arising from the large-scale support of digital transformation helped attract talent from the private sector, as Kotka states:

> *The good part was that in ICT there [were] very few legislation initiatives. It was mostly about inspiration, it was mostly about fixing investment processes, getting the right resources and strategies in place. It was more like organising work than working the policy or the legislation. ICT and cybersecurity are not regulated at all, basically. It's a very low-regulated effort.* (Taavi Kotka interview)

In the 1990s, if the hiding hand style of charismatic leadership was provided mostly by politicians, then in the 2000s it was provided increasingly by strategic advisors and recruits from some of the most prominent Estonian ICT companies.

2.3. Design and choice
Following Ubar's guidance, a fundamental principle of Estonia's digital transformation efforts was the idea of no legacy. As mentioned earlier, government ICT projects could not afford to build massive systems run by large vendors. Instead, the government was encouraged to embrace a distributed architecture of IT systems to cater to the different needs of each government agency. This became an explicit strategy from 1999 onwards: ministries were asked to build their IT systems according to their specific needs, but ensuring frugality and interoperability across government. The resulting distributed architecture created the need for a software layer that allowed these distributed IT systems and databases to exchange data with each other.

Laar's second government rapidly expanded x-road as a layer for secure data exchange for distributed public IT systems and databases, followed shortly after by digital signature and e-ID based on the unique personal code. Viik and others were able to tap into personal networks in the public and private sectors, for example in the banking sector, which helped develop competency in cybersecurity (Kerem 2003). In this way, the public ICT infrastructure – with its fundamental principles of governance: distributed data architecture and strategy, central strategic guidance and financial controls, and decentralised implementation – worked with public-private networks to access competencies and increase legitimacy.

Despite this seemingly coherent strategic move, Estonia has never had a central digital agency, nor does it have centralised or even unified public databases. Instead, politicians and civil servants have relied on cross-sector networks for strategic advice in pushing their digital transformation agenda forward. Viik notes:

> *…the overall ICT policy coordination and formation were carried out by, I would say, a central group of some 10 to 15 people, and a broader group involving maybe 20, 25,*

persons who, twice a year, sometimes three times a year, had seminars and reviews on what should we do next. (Linnar Viik interview)

This is highly unusual in Estonia's political and bureaucratic culture. Most neoliberal political cultures mistrust close-knit networks or the heavy influence of private sector actors on public sector representatives, and are acutely sensitive when it comes to corruption and the erosion of accountability associated with such networks. In the Estonian ICT sector, the networks and exchanges between the private sector and government operations rely heavily on each other's advice and guidance – and are the trusted backbone of its digital transformation efforts. In fact, belonging to these networks is more important than having a formal government role. This is even more remarkable in the Estonian context where in all other policy fields one of the key complaints is lack of cooperation and weak coordination structures (Randma-Liiv and Savi 2016).

Despite the potential accountability threat, the ICT sector has remained relatively scandal-free over the past two decades, with little evidence of corruption, influence or accountability issues. The most critical moment occurred in 2007 when Estonia became the first nation state to fall victim to a coordinated Distributed Denial of Service (DDoS) cyber attack (Lesk 2007). The continued attacks led to the establishment in Tallinn of NATO's cybersecurity centre. Following the initial attack, the country had to repair its services by disconnecting from the Internet for four weeks and a strategic intent emerged that focused on collective rather than individual actions. According to Andres Kütt, a principal advisor to the Estonian Information System Authority:

Strategically this is from where [the network] emerged. The ideology from it actually stems from what our former Director General Jaan Priisalu called the collective brain, which is primarily behind the cyber war ideology of Estonia. The doctrine is that in cyber conflict the party who can amass the biggest collective brain wins, because in the Internet world everything is interconnected and no one single organisation can withstand attacks or can sort of execute attacks en masse alone. So you need to have that sort of collective brain and the collective brain being distributed needs to work together, there needs to be trust between parties in that brain, so that network stems from that sort of ideology. (Andres Kütt interview)

The close-knit network among high-profile politicians and their private sector IT advisors also emerged as a natural development from the fact that public-private partnerships initiated significant IT investments and digital services as joint ventures with Scandinavian state-owned companies, principally the banking industry. With electronic banking proliferating in the late 1990s, banks were at the forefront in rolling out the national e-ID (initially bank offices issued e-IDs). Through the educational Tiger Leap and Look@World programmes of the late 1990s and early 2000s, the banks financed IT education in schools and for the broader population, so that citizens could use their online services. In essence, the banks took over the task of training and informing citizens who might not naturally be drawn to conduct online transactions and preferred physical bank branches:

In was in the banks' self-interest not have a bank branch everywhere, so they embraced electronic banking. So what they did for a while was to teach people in rural areas, especially older people, how to use computers. (Toomas Hendrik Ilves, former President, former Minister of Foreign Affairs, interview)

The banks deployed training kiosks across the country to bring their clients online. Also, Hansapank, the leading bank at the time, built up the data infrastructure and hired cybersecurity specialists to protect the banking system. Some of the top cybersecurity people moved from banks to the government, which proved vital in responding to the DDoS attack in 2007 and paved the path for continuous personnel movement between sectors.

2.4. Delivery, legitimacy and endurance

Estonia's early focus on integrating IT education with general school education was an essential factor in enabling digital transformation. Funded both by public and private sector organisations, the Tiger Leap programme was initiated by Jaak Aaviksoo and Toomas Hendrik Ilves in 1996: a first step was to bring all Estonian schools online. Private sector companies became involved in a co-sponsored public-private partnership called Look@World. Both programmes had an immediate effect on Estonian youth and led to the emergence of a vibrant IT start-up sector and, arguably, to improvements in government operations in recent years:

> *The last several years, when I went around visiting Estonian start-ups, I always asked them why did they end up in technology and they would say 'Oh, well I was a Tiger Leap child.' So now people in their mid-30s are people who were 14 or 15 [when they] got online.* (Ilves interview)

The subsequent success of IT start-ups such as Kazaa and Skype provided further stimulus:

> *What really transformed young people's attitude was the success of Skype. Basically, there were four, at that time, young Estonians, who managed to avoid doing prison time in the United States for inventing Kazaa, which was a file-swapping program, like Napster, and of course it violated copyright laws. And then the same group of four, because the technology concept's fairly similar, invented Skype. And the idea that in this sort of faraway, provincial, cold, rainy, backward backwater, which is kind of the concept young Estonians had of where they lived, some people who were good at math and could invent a worldwide brand and become rich was an enormously motivating factor to get people interested in technology.* (Ilves interview)

In particular, the Tiger Leap programme can be seen as a blueprint for how digital transformation was delivered. The programme was initiated in 1996 through a legally private foundation in which government was one of the founding members and key funders, alongside 11 IT companies. It created competitive grants and encouraged schools and local governments to submit applications for the rather limited government funding for IT education programmes. In essence, this governance structure created a highly agile environment, where those willing to invest their time and energy could be easily engaged either as funders or participants and it did not matter whether they belonged to the public or private sectors. Above all, such fluid structures allowed private actors, notably banks, to be heavily engaged in the Tiger Leap programme. Importantly, foundation-based structures allowed public-private networks to operate outside of government without much red tape – and without much institutionalisation or formalisation.

The networked cooperation between the public and the private sector occurred as a natural evolution: CEOs, non-profit managers and academics were moving between different sectors, accepting short-term appointments in government or being asked to serve as strategic advisors to the prime minister

and the president. The phenomenal success of Estonian IT start-ups like Skype gave rise to another powerful network of Estonians with ICT skills who are members of its local start-up ecosystem (the 'Skype mafia'), mostly developers and entrepreneurs with shared values and ideas[10]. Thus, layers of trusted network relationships have evolved between public and private organisations that focus on exchanges and strategic planning initiatives. Many of those incorporate prominent Estonian IT companies, such as Cybernetica, Nortal or Skype, which are active in the cybersecurity, e-government and banking industries.

Movement between sectors is not one-directional. Government agencies have, for example, signed a memorandum of understanding with Nortal, which allows the company to request government officials to work on international client projects abroad. Frequently, public managers are sent on leave to work on international projects, for example in Oman, lending deep public administration expertise and understanding of government systems to the private sector. These developments are not immune from criticism, as described by a former government official:

> *I have a huge thing with, for example, Cybernetica. I think the government cannot support [only] one company. You have the Estonian government that supported Cybernetica with lobbying, promoting, everything. And they still complain. I hate it. I think it's one of the biggest frauds in Estonia. It's like a scientist taking money from a university and at the same time from social funds from the government, and still they can't sell it.*

Another layer – beyond the consultative layer – is the information exchange and networking layer of cybersecurity experts who regularly meet as an informal group. Their goal is to exchange knowledge and good practices to protect the country's infrastructure against cyber attacks. Ties among participants are extremely strong and take on a regulative function since the informal network members include representatives across all industry sectors. For instance, failing to fall in line with what is decided in terms of processes and technologies can lead to exclusion from the network. This has a real impact, as one of the network organisers explains:

> *It is a small community, but it can still to an extent deliver. In the sense that it is acknowledged that the formal mechanisms can get you that far, but true cooperation between parties only happens via personal contact. We need to have some level of personal rapport with people. Yes, at the end of the day, you can whack somebody with a piece of law, or regulation, or a process, yes, you can do that, but it is very limited and has a very limited effect.*

The design principles of the Estonian digital transformation are a result of the strong political decision-making and networked governance. Some of these are ingrained in the policy-making culture, others in the explicit legal codex. The most influential design principles are not, however, codified in law or regulation; instead, they are followed by those in leadership positions in government. They bear the hallmarks of what can be dubbed 'civic hacker culture' that fuses start-up agility with design thinking. The once only principle, designed to reduce the bureaucratic burden (Wimmer et al. 2017), is a case in point. Citizens and businesses provide their information to

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[10] See http://skypemafia.com.

government only once and thereafter this information is available to all other government actors. In Estonia, this is a principle, not a law. As Kotka explains:

> *It's not a law. People think it's a law, it's not a law, it's a principle. So there's no law saying that the government can ask only once for information from the people. This is so in the case of companies, but about the people it's a principle.* (Kotka interview)

Similarly, the high level of interoperability made possible by components such as the x-road data platform and its connected applications are also not mandated by law:

> *Or the saying [that] an ICT system has to be interoperable with other systems. Again, it's a principle. There's no legally binding regulation.* (Kotka interview)

Nor is it a rule that the Estonian public sector should not use IT technologies that are more than 13 years old or avoid off-the-shelf IT systems offered by large international vendor companies. Instead, such principles emerged from early thinking typified by the Ubar memo and reflect the start-up culture of that time, of which Skype and its later alumni, the Skype mafia, are examples.

This development of informal networks can be summarised as a specific kind of 'mission mystique' that spans organisational boundaries. Goodsell (2011: 477-478) calls mission mystique a set of institution-strengthening characteristics and institutional charisma. In the Estonian ICT sector, such mission mystique transcends organisational institutions and strengthens networks that are driven by common values and held together by (digitally savvy) charismatic leadership. Such mission mystique is essential for the hiding hand principle by creating legitimacy for risk-taking and experimentation.

3. Analysis and conclusions

At the core of Estonia's digital transformation is the idea of a digital citizen who accesses public and private services through a digital platform that ensures the interoperability of diverse and decentralised information systems. This relies on ideas that are counter-intuitive to free-market thinking and follow a principle characterised as the 'hiding hand' rather than the 'invisible hand'. Two elements were essential: first, the adoption by politicians and policy-makers of a culture of risk-taking and bold ideas; and second, the formation of multiple overlapping small networks to promote early success and build momentum. In Estonia, these phenomena became mutually enforcing and enabled rapid adoption of innovative solutions.

To summarise, Estonia's digital transformation and its success rest on three key factors: first, a confluence of a number of contextual factors; second, a set of agreed upon governance principles; and third, a set of design principles, as follows.

3.1. Contextual factors

- The Soviet legacy had left Estonia with an outdated industrial structure and widespread aversion to industrialisation. More positively, it left Estonia with a wealth of R&D talent in ICT through various Academy of Sciences institutes, such as the Institute of Cybernetics (established in 1960) and other similarly highly advanced academic institutions. As their funding collapsed in the early 1990s, much talent poured into emerging private companies, in particular various joint ventures with Scandinavian telecoms and other companies.

- Estonia has geographical proximity to Scandinavia and in the 1990s the Nordic countries had one of the fastest developing telecommunications sectors globally. Opening up both policy-making processes (through advice and joint ventures) and markets (through privatisation and regulations) to Scandinavian partners brought know-how and investment.

- Estonia is a small country with a high population concentration in its capital city: almost one third of its 1.3 million inhabitants live in Tallinn. This clustering of population facilitated agile networks that were able to gain quick and lasting political support, and which required low initial infrastructure investment.

3.2. Governance principles

- Government ministries and their agencies had direct responsibility for their ICT strategies, investments and data – and information architecture and departmental ICT strategies were decentralised.

- A critical coordinating and guidance function in negotiating ICT investment decisions and the formulation of crucial design principles was performed in the centre. During the 1990s the prime minister's office played this vital role and it is now coordinated by the Ministry of Economic Affairs and Communications.

- There was a deliberate focus on public-private networks rather than on individual organisations. Estonia's e-government landscape consists of a number of organisations (agencies such as the Information System Authority or departments within ministries such as the Department of State Information

Systems) and cross-organisational networks that are sometimes formalised (such as the Estonian Defence League's Cyber Unit.[11]

3.3. Design principles

- No legacy principle: public digital infrastructure should not use technological solutions that are older than 13 years.
- Build versus buy principle: the priority is to build systems from scratch rather than buying 'off-the-shelf' software systems from ICT vendors (this was particularly true for Estonia in the early stages of digital transformation).
- Once only principle: businesses and citizens have to supply information for government authorities only once and data is available across government agencies through the data exchange layer x-road.
- Interoperability and security principle: rather than seeking to create unified databases and information systems, the focus is on the secure interoperability of data systems.

Together, the coordination of strategy, social conditions and policy combined with a uniquely talented, motivated and relatively young workforce resulted in the creation of a public digital infrastructure that is recognisably world class.

The rapid pace of change, and the focus on digital citizenship and identity, have nonetheless highlighted anomalies. In the first place, despite the statement of a strategic intent of participatory governance, innovation – and in fact the drive for digital initiatives – has come from a tight-knit elite network of politicians, business leaders and civil servants, and few ideas have emerged through co-creative processes with citizens. The recent e-residency programme is one of the only initiatives that places a strong focus on user feedback. Second, while e-ID and other advances have changed aspects of the user experience of crucial public services such as the electronic submission of tax declarations, the services themselves have remained remarkably unchanged. Third, while many digital services have brought efficiency gains to citizens and businesses in Estonia, citizen satisfaction with crucial services such as healthcare and education has remained low. As an example, according to OECD rankings in 2014, Estonia ranked fifth from bottom in satisfaction with health services (in 2007 it ranked the lowest) and second from bottom in education system satisfaction (in 2007 it ranked third lowest). Further, Estonia performs poorly on some critical social indicators. For example, in 2016 it had the highest gender pay gap in Europe and a higher than EU average Gini index (Eurostat). While citizen satisfaction is not the only measure of the quality of public services – and digital infrastructure is only one component in the provision of sophisticated services such as health and education – it is indicative that there is a little measured improvement in the provision of core public services.

While the decentralised digital agendas of line ministries have provided needed agility, they have also created uneven digital capabilities across different departments and agencies. This reliance on bottom-up departmental initiatives seems to necessitate stronger and perhaps more formalised coordination structures than are currently present.

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[11] See http://www.kaitseliit.ee/en/cyber-unit.

Furthermore, while e-voting is increasingly popular, other aspects of digital democracy, such as civic engagement, have remained weak (with the notable exception of the so-called Citizen Assembly of 2012-2014, which, however, failed to deliver any significant results; see Jonsson 2015).

Finally, while distributed IT architecture is at the heart of Estonia's digital transformation, the central x-road layer represents a dependency: 'It's the x-road or no road.' While Estonia has already successfully exported this proven infrastructure to other European countries, such as Finland, there are alternative paradigms that do not rely on it (for example, the UK's domain- and platform-focused approach).

Estonia's focus on ICT as general-purpose technology has proved to be one of the critical success factors as it enabled Estonia to create a digital infrastructure that is universal in nature. Yet by relying on decentralised and mostly informal networks to build this infrastructure, Estonia now faces a challenge to build capacities and capabilities within the public sector to take advantage of the public digital infrastructure.

In summary, perhaps the most significant question faced by Estonian digital government is whether the main reasons for its success – particularly its charismatic leadership-based informal networks and civic hacker culture – provide enough capacity to harness the potential of Estonia's digital infrastructure for more inclusive public services and society.

Appendix

Interview data includes the following interviews (affiliations at the time of the interview):

	Name	Position	Sector
1.	Ain Aaviksoo	Deputy Secretary-General for E-services and Innovation Ministry of Social Affairs Republic of Estonia	Government
2.	Andre Krull	Partner, Board Member Nortal	Private sector
3.	Andres Kütt	Advisor at Estonian Information System Authority Republic of Estonia	Government
4.	Dan Bogdanov	Head of Privacy Technologies Department Cybernetica	Private sector
5.	Indrek Neivelt	Former CEO Hansabank Group CEO & Co-Founder Pocopay	Private sector
6.	Ivar Tallo	Former Member of Estonian Parliament Founder of e-Governance Academy Member of the Supervisory Board E-Government Academy	Non-profit/ academia
7.	Jaak Aaviksoo	Former Minister of Culture and Education (1995-1996) Former Minister of Defence (2007-2011) Former Minister of Education and Research (2011-2014) Republic of Estonia Rector, Tartu University (1998-2006) Rector, Tallinn University of Technology (since 2015)	Government and academia
8.	Janek Leis	Head of Intelligence Department Estonian Tax and Customs Board	Government
9.	Janek Rozov	Head of Department of Information Society Services Development Ministry of Economic Affairs and Communications for Estonia Republic of Estonia	Government
10.	Karin Rits	Head of Information Society Unit Ministry of Economic Affairs and Communications Ministry of Economic Affairs and Communications for Estonia Republic of Estonia	Government
11.	Kaspar Korjus	Managing Director e-Residency Enterprise Estonia Republic of Estonia	Government
12.	Linnar Viik	e-Governance Academy University of Tartu Various start-ups Republic of Estonia	Private sector
13.	Marek Helm	Deputy Secretary-General Ministry of Interior Republic of Estonia	Government
14.	Marika Priske	Secretary-General Ministry of Social Affairs Republic of Estonia	Government
15.	Mart Laar	Prime Minister (1992-1994 and 1999-2002) Republic of Estonia	Government
16.	Merike Saks	Secretary-General at Ministry of Economic Affairs and Communications Republic of Estonia	Government
17.	Oliver Väärtnõu	CEO Cybernetica	Private sector
18.	Ruth Annus	Head of Migration and Border Policy Department	Government

	Name	Position	Sector
		Ministry of Interior Republic of Estonia	
19.	Siim Sikkut	Digital Policy Adviser at Government Office of Estonia Ministry of Economic Affairs and Communications Republic of Estonia	Government
20.	Sten Tamkivi	Former CEO of Skype Teleport	Private sector
21.	Taavi Kotka	Government CIO Deputy Secretary-General – ICT Ministry of Economic Affairs and Communications Republic of Estonia	Government
22.	Thomas Hendrik Ilves	Former President Republic of Estonia	Government

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