Internet Banking as a Platform for E-Government

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***Abstract*—The paper contributes to the literature on digital platforms as well as the role of entrepreneurial innovation in both the private and public sector. It emphasizes the importance of private-sector platforms in e-government service delivery as well as the importance of entrepreneurial discovery processes in e-government service delivery. New Estonian retail banks introduced internet banking in 1996 with the aim of making their services more efficient and enhancing customer satisfaction. However, the unintended consequence of this service was the utilization of internet banking platforms by government agencies to deliver public services. As internet banking became widely used, government agencies started to experiment by offering online services on the basis of internet banking platforms. Internet banking allowed government to authenticate users, which was fundamental for delivery of public-sector services such as submitting tax declarations online. Alternative options, such as using credit cards, were not available, as credit cards were then not in widespread use in Estonia. The use of internet banking platforms unleashed a path-dependent process which allowed the development and delivery of even more sophisticated online services. It served also as a stepping-stone to forming public-private partnerships in order to launch new identification methods such as the ID card and Mobile ID. Hence, internet banking played a fundamental role in the emergence of e-government services in Estonia.**

Keywords — e-government, internet banking, platforms, authentication, ID card, innovation, entrepreneurial discovery process, private-public partnerships.

I. INTRODUCTION

The recent literature has emphasized the importance of the rise of online platforms in economic, social, cultural, and political affairs and interactions [1]. This set of literature refers particularly to private-sector platforms such as Facebook, Amazon, Uber, and others that have dominant market positions. Platforms are also crucial in governance as e-government scholars have increasingly started to discuss e-government as a platform and emphasized the importance of platform-based governance [2].

While this literature is relatively new, platforms themselves started to emerge 20 years ago. This article explores one such case, and how Estonian e-government services have exploited internet banking as a platform for user authentication and online service delivery.

In addition, this paper introduces a new angle to the literature as thus far the focus has been primarily on private-sector platforms such as Uber or Facebook, or on government platforms. However, both private- and public-sector platforms can interact in a number of intentional and unintentional ways that create new opportunities and challenges for platform-based e-governance.

This paper connects the e-government literature with the literature on innovation and entrepreneurial discovery processes. Foray [4] and McCann and Ortega-Argiles [5] argue that regions not only have different technological and industrial capabilities, but they also differ in their evolutionary trajectories. This is essential for understanding the emergence of online platforms and online service diffusion because it reveals that diffusion may take different routes in different environments depending on local context and time. There is no one-size-fits-all, ahistorical, non-spatial model that can explain the emergence of e-government or any other online service delivery.

The traditional approach to innovation emphasized the role of research and development (R&D), but the disconnect between R&D and entrepreneurial activity is one of the core problems in many countries [6]. Instead of high-level policy-making and a scientific approach to innovation, Foray [4] stresses the importance of decentralized entrepreneurial knowledge in the development of new domains that can adopt and adapt ICTs. There is significant information asymmetry between policy-makers and entrepreneurs, and policy has to rely on information gained through an entrepreneurial process of discovery.

According to McCann and Ortega-Argiles [5], an entrepreneurial process of discovery allows for the identification of new domains for technological development. The degree of embeddedness, and the relatedness of the domain, increases the impact of innovation developments across different activities and sectors. It must be noted that what is known as “smart specialization literature” defines entrepreneurs very broadly; public universities and research institutes can be entrepreneurial and part of the process of

entrepreneurial discovery. It is also possible for policy makers to be entrepreneurial. Hence, there is some overlap with what Mazzucato [7] calls the "entrepreneurial state." The understanding of the entrepreneurial discovery process is also consistent with what Room [8] and Crouch call "institutional entrepreneurs." They are "creative political schemers, looking for chances to change and innovate" [9].

The role of entrepreneurial discovery in contributing to the diffusion of spatial and local context in innovation shares with the Schumpeterian understanding of innovation an emphasis on entrepreneurs. Entrepreneurs do not operate only in the private sector, but can also be found in the public and non-governmental sectors. Even though the emphasis in this research is on financial services, it must be pointed out that in some countries, financial services are provided by government-owned entities. Furthermore, platforms offered by financial services and other business services have important social functions. For example, internet banking saves time and makes transactions more efficient for businesses but also for individuals, NGOs, and government agencies.

Most importantly, the entrepreneurial discovery process in the public sector is a fact of life. However, if left uncontrolled it may easily develop into rent-seeking, where benefits are concentrated and privatized, and costs are diffused and socialized. The case of internet banking in Estonia represents a balance between facilitation of the entrepreneurial discovery process and rent-seeking risks. On the one hand, it is clear that the use of internet banking as a platform benefited retail banks. On the other hand, it cannot be confirmed that the outcome resulted from deliberate rent-seeking by retail banks.

For those unfamiliar with the Estonian context, the emphasis on internet banking as a platform for e-government may seem unusual. However, quick uptake of internet banking provides another critical juncture for the emergence of e-government services as well as the diffusion of internet. The internet banking was introduced in 1996 when the internet diffusion was still making baby steps in Estonia. Thus, it provided crucial reason for getting online – particularly as banks encouraged their customers to use this option in order to cut costs and provide more efficient service. Already in 2002, internet banking classified as the third most important reason for internet use among Estonian population, behind communicating via email and using search [3]. Most importantly, Estonian Tax Authority started to offer online services on the basis of internet banking platform already in 2000.

As far as research methods are concerned, the paper uses secondary sources and descriptive statistics as well as issucrawler.net for online network analysis. In order to highlight important aspects comparisons are made with other countries in Central and Eastern Europe (CEE) as these countries are through their historical, political and economic trajectories most similar to Estonia.

The paper is organized in a following way. The next section discusses the evolution of internet banking in Estonia and online government services. Then the role of Estonian Tax Authority and authentication methods will be explored. This is followed by conclusion and implications.

II. Internet Banking and E-Government: Providing Public Goods on a Private Platform

A. The Emergence of Internet Banking

Internet banking was introduced by Estonian retail banks Hansapank and Ühispank, which were essentially start-ups in the 1990s. Both banks were taken over by Swedish banking groups Swedbank and SEB in the late 1990s. However, in many ways Estonian internet banking solutions were superior to Swedish internet banking solutions and Swedish banking groups actually learned from the Estonian experience. In other words, reverse technology transfer took place—it is usually assumed that superior technology is transferred from economically more advanced to economically less advanced countries.

In the 1990s, new Estonian banks were not constrained by path dependencies stemming from technology and business models, as there were no old legacy banks. The Soviet banking system was undeveloped. It was, to a great extent, a cash-based system. The use of checks was not widespread. Thus, it was possible to start with a blank sheet and avoid the same development trajectories followed by more advanced countries. This provided a critical juncture because Estonian banks did not have to deal with the legacy costs and path dependencies of older banking systems. It was possible to move from a cash-based system to internet banking without ever introducing checks or other old technologies.

Where a typical bank in the West, such as Bank of America, has essentially made its checkbook-based system electronic and called it internet banking, the Estonian internet banking was exploiting the real advantages offered by the internet and delivering speedy and high quality of service from its beginning in 1996. Transfers could be made in the same day, within one hour in the same bank and a few hours between different banks, instead of the customary wait of at least 24 hours. It was cheap, as most consumers using the service did not even qualify for credit cards in 1996.

The quality, security and simplicity of internet banking service attracted the majority of Internet users as its customers [3]. In 2005, 35 percent of Estonian people used internet banking. In 2016, the use of internet banking was almost universal among internet users, reaching 80 percent of the total population. As Figure 1 below shows clearly, Estonia's lead in internet banking is exceptional among the CEE countries that joined the EU in 2004 and 2007 as well as in comparison with EU average.

A comparison can be made with Slovenia, which is the wealthiest country in the CEE and among those countries that

joined the EU in 2004 and 2007. In 2005, the use of internet banking in Slovenia was just over a quarter that of Estonia, and in 2015, Estonia's usage was almost 2.5 times larger. Slovenia has not been a laggard only in comparison with Estonia, but also when compared with the Czech Republic, Latvia, Lithuania and Slovakia. Only 4-5 percent of internet users used internet banking in Romania and Bulgaria in 2016.

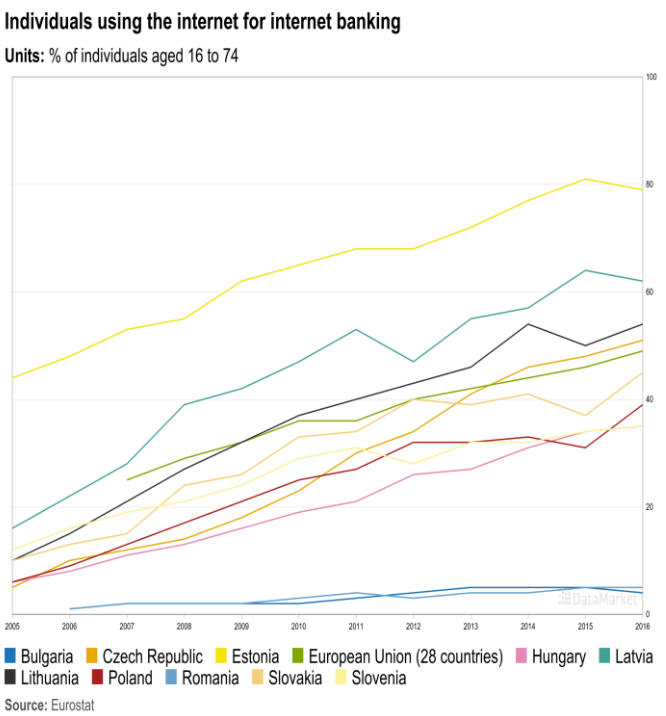

Fig 1. Individuals using the internet for internet banking in selected CEE countries and the EU, based on data from Eurostat (2017).

The huge variance of outcomes can be understood in the context of the epistemological nature of technology and the role of the local context in internet diffusion. Even though various internet banking solutions have been available for 20 years, these solutions have not diffused evenly through countries characterized by relatively similar socioeconomic development, such as countries joining the EU in 2004 and 2007.

B. Online Government Services and Internet Banking

It is important to keep in mind that most people do not need to interact and make transactions with the government often. At the same time, using banking services may be a daily or weekly necessity. According to Alexa.com data on the top sites in Estonia in 2015, the government portal eesti.ee, a gateway to different government online services, is ranked number 113 among the top sites in Estonia. At the same time, the website for the largest retail bank by market share in Estonia, swedbank.ee, was ranked number eight, and that of the second-largest bank, seb.ee, was ranked number 16 among top websites. The websites of smaller banks lhv.ee and Nordea.com were ranked at 62 and 110 respectively. In other words, even small banks beat the central government portal in attracting users. In the interests of objectivity, it must be noted that the capital city's website, Tallinn.ee, was ranked number 49, and rik.ee, which provides online access to land, property and enterprise registers, was ranked number 65 [10].

Figure 2 provides historical traffic trends showing that websites of the two largest banks, www.swedbank.ee and www.seb.ee, have considerably higher global rankings number of visitors than the three most popular public-sector websites—www.tallinn.ee, www.rik.ee and www.eesti.ee.

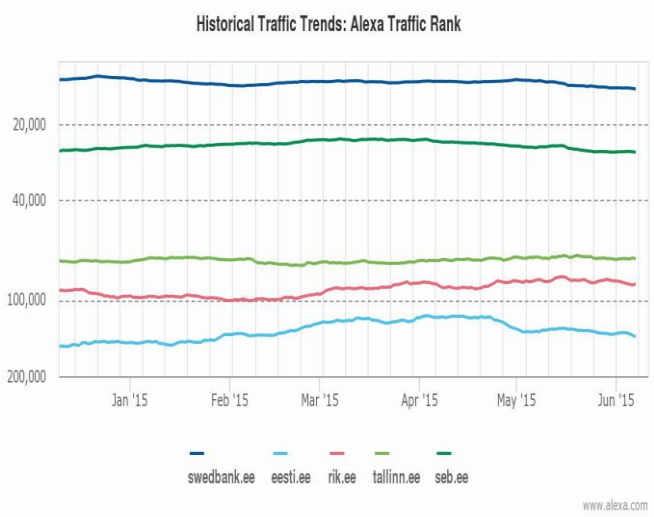

Fig. 2. Top government and bank websites in Estonia from January 15 to June 15, 2015, based on global traffic ranking data from Alexa (2015).

This indicates two trends. First, many users go directly to the subwebsites of government services rather than accessing them through the government portal. Second, the websites of large banks attract considerably more users than any government service. The data collected by Alexa is based on monthly traffic rank that is a combination of average daily visitors and page views over the past month. Of course, monthly data may not be representative of broader trends and some websites may experience considerable volatility in visits on a monthly basis.

Nevertheless, all these websites are well established in Estonia and have loyal visitors. We can assume that most visitors need to access banking and government services with certain regularity and are not likely to change their bank or government often. Hence, it can be characterized as a path-dependent process, where the initial decision to use a particular bank and its internet banking services will lead to regular use of those services.

For the sake of understanding the importance internet banking has in Estonia, Figure 3 compares the top government and bank websites on the basis of global traffic rankings with Slovenia. Slovenia's results are the opposite of Estonia's.

Slovenian government portal is ranked almost as high as the most popular bank website in Estonia, while the website of the most popular bank in Slovenia lags significantly behind top bank website in Estonia by global ranking—the global ranking for nlb.si is 56,306, in comparison with the ranking of the largest Estonian bank, swedbank.ee, at 14,324.

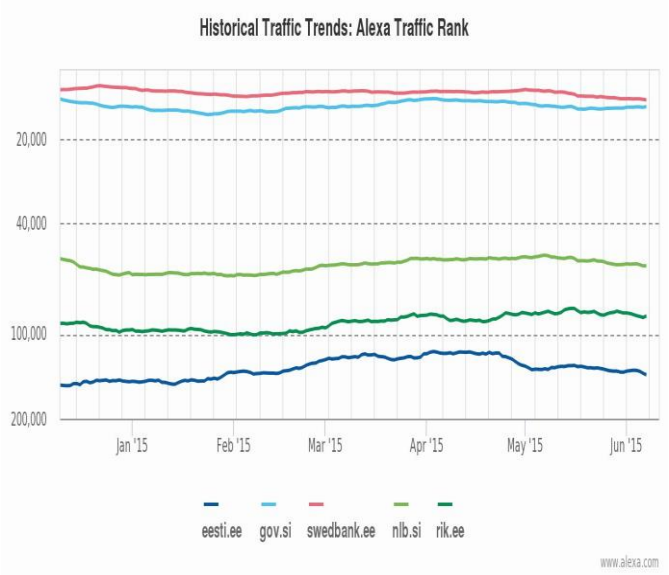

Fig 3. Top government and bank websites in Estonia compared with top bank and government websites in Slovenia from January 15 to June 15, 2015, based on global traffic ranking data from Alexa (2015).

It must be kept in mind that the Estonian population is 1.3 million while Slovenia's population is 2 million, and in absolute terms Slovenia has a higher number of internet users as well as regular bank customers. Hence, one would expect Slovenian websites to be more popular by global ranking than Estonia's websites. To illustrate this key difference further between Estonia and Slovenia, it must be pointed out that the Slovenian government portal, gov.si, is ranked number 11 among the top websites in Slovenia on the basis on monthly data. Slovenia's largest bank nlb.si is ranked 56 among the top websites in Slovenia.

C. Internet Banking as a Platform for the Estonian Tax Board

Many Estonian state agencies started to use the identification verification offered by internet banking, thereby enabling government services online. The Estonian Tax Board developed a new software solution in cooperation with companies Sema Group Belgium and AboBase Systems, and began offering the option of declaring taxes online in 2000. The availability of a bank-based online identification system allowed them to do so. In fact, in online banking environments it is possible to enter the Tax Board's webpage directly and declare taxes online. In 2014, 95 percent of Estonian residents declared their taxes online.

According to Aivar Sõerd, General Director of what was then known as the Estonian Tax Board from 1999 to 2003, the implementation of online services cost taxpayers only EUR 85 000 [11]. "Cooperation with banks led to considerable cost savings,"[1] wrote Sõerd. He emphasized that the "two largest banks at that time, Hanspank and Ühispank, offered the government an opportunity to rely on their bank portals to log in to the (Tax Authority online) environment" [11].

It is obvious from these comments that the main focus was on cost-saving and control. As identification tools had been made available by retail banks, the Tax Board relied on them. Questions about whether the use of private-sector identification methods were acceptable or not for the provision of government services were not discussed. It was implemented as a Tax Board service project, and it did not require any special legislation or wider discussion in government. The functional focus on implementing a concrete project by a specific government department without consideration of the broader issues and without a general government strategy fits neatly into what Kitsing [12] calls "success without strategy" in discussing the development of Estonian e-government. It is also a prime example of entrepreneurial discovery process in delivering e-government services.

Let us recall the brief discussion of smart specialization literature in the introduction, in which entrepreneurs are defined very broadly: policy makers, public universities and research institutes can be entrepreneurial and part of the process. In many ways, the development of online services by the Estonian Tax Board is also consistent with Mazzucato's concept of the "entrepreneurial state" or what Crouch calls "institutional entrepreneurs" [9]. Mazzucato emphasizes that different public sector bodies can contribute towards innovation outcomes. It need not be the sole preserve of central government and centralized top-down policy-making [7].

The Tax Board's Aivar Sõerd and his employees acted as entrepreneurs by making tax declarations accessible online to public and minimizing costs in doing so. According to Sõerd [11], the project was implemented in two phases: there was a pilot project in 1999, and in 2000 full service was made available to individuals and companies. The Tax Board's online services were used by 12,000 people in 2000, which consisted of submitting and correcting income and value-added tax declarations, making inquiries about tax liabilities, and other transactions.

Sõerd argues that the Tax Board's online services have in principle remained the same between 2000 and 2015, and that this should serve as a model for the optimization of government services. Again, his focus is on optimization, and for him, the public sector "is by nature a large organization which offers public services" [11]. The emphasis is once

[1] Direct quotes from Sõerd (2015) are translated by the author from Estonian into English.

more on functionality, and tax declaration services are viewed in the same way as any other service available in the private sector.

Figure 4 shows an online network analysis of Estonian e-government websites, which was carried out by inserting key Estonian e-government services' websites into issuecrawler.net. It shows a relatively centralized network, where the central point is emta.ee—the website of Estonian Tax Board. Most importantly, the central e-government portal, eesti.ee, is featured less prominently on the periphery of the network representing the e-government ecosystem and is connected to the Tax Board through several network nodes. Basically, by using internet banking as a platform, the Tax Board has managed to establish itself as the most important e-government service in Estonia. It is a prime example of a platform on platforms, and in this case in particular, a public platform on several private platforms. Essentially, it makes the Tax Board's platform semi-public.

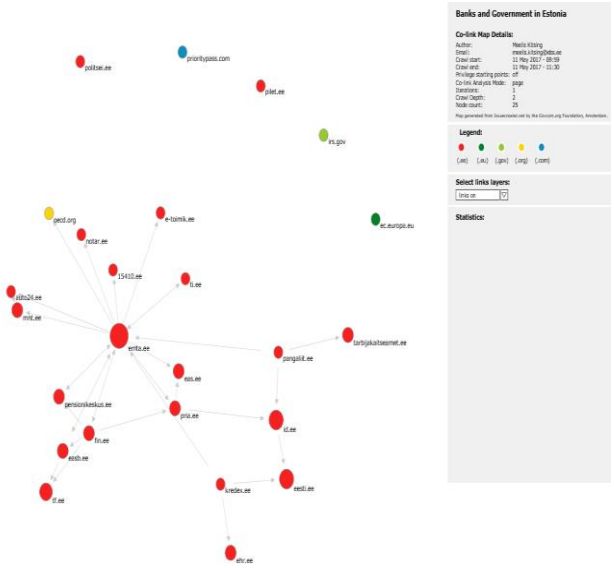

Fig. 4. Online network analysis of Estonian e-government websites, compiled by author through issuecrawler.net (2017).

D. Internet Banking and Diversity of Authentication Methods

Similarly, many private companies offered services that were accessible through internet banking, essentially turning banks into verifiers of online identities. Essentially, this is a service that is provided by five major banks to third parties [13]. For authentication, banks provide password cards containing 24 one-time passwords, and PIN calculators that function as offline card readers with a keypad. The customer needs to insert his bankcard into the reader, which generates a PIN code that must be entered when accessing online banking services.

The system that was introduced by Estonian banks was, even then, more sophisticated than the system used by many American or Western banks today, where, for example, only a password and username is required. This system, introduced in 1996, is still in use, even as its role has gradually been scaled back, making way for newer identification methods such as the ID card and mobile ID. By 2009, one million bank password cards, 50 000 pin calculators, and about one million government ID cards were in use [13].

The relative use of the bank-based ID in comparison with the government-issued ID card in online environments cannot be verified because the data is not available publicly. However, leading authentication expert Tarvi Martens wrote in a 2010 article that the bank-based ID system is still more widely used than government-issued IDs, accounting for 80 percent of all online transactions [13].

In 2002, the government introduced electronic identification cards that can be used as identification method for online transactions. One reason the government introduced ID cards in 2002 was to provide a more secure and sophisticated substitute for online identification methods provided by the internet banking. Work on the ID card project started in 1997, but it took three years to prepare a draft law called the Digital Signature Act. The decision to go ahead with the project and deliver cards to every citizen was one of the last decisions of Prime Minister Mart Laar's government in October 2001 [13].

The decision led to the establishment in 2001 of the private company AS Sertifitseerimiskeskus by telecom operators and the two largest banks. The company was essentially the ID card certification center and at the center of the network of applications and businesses built around it. In the early years, the ID card received considerable public criticism and there was initial outrage over the investment of twenty million euros in the project [13].

Martens stresses that government agencies were initially not active promoters of the ID card, but they gradually began promoting and procuring new software for their use. Since major private-sector players were behind the project—by becoming shareholders in the company responsible for certification process—the ID card gradually took off and public attitudes became more accepting. "This unique setup of private and public cooperation with strong players allowed the building of a uniform platform," writes Martens [13]. There were also attempts to challenge Sertifitseerimiskeskus's monopoly by Cybernetica—the private developer of the X-Road system discussed below, as well as internet voting in Estonia—which launched alternative tools based on different standards in 2002. However, this competition ended in 2008 when a uniform standard prevailed.

Even though it became mandatory to have an ID card, it was not compulsory to use it online. As noted above, the previous simple identification method provided by internet banking has remained the primary form of online identification. Even though the government had issued a half million ID cards by March 2005 (the population of Estonia is 1.3 million), and had reached 1 million by 2009, the new identification method did not immediately get a considerable following in online environments [13, 14].

These cards can be used offline—the ID card is a regular identification card with a chip that also allows it to be used online. Bank-issued online identification cards have been used prior to and in parallel with the ID card as an identification method for government-provided online services. Overall, only 25,000 ID card owners used their cards online in 2006 – four years after the launch. In 2009 the number of online users of ID card had increased ten-fold to about 250,000 [15]. Between 2002 and 2012, 500,000 people had authenticated themselves electronically with the ID card at least once, with a total of 131 million authentications, or 260 authentications per user during this ten-year period. Out of these 131 million transactions, 78 million were digital signatures, which suggests that by 2012, the average user had given 156 digital signatures. Figure 5 below gives an overview of the growth of digital signatures and authentications by ID card.

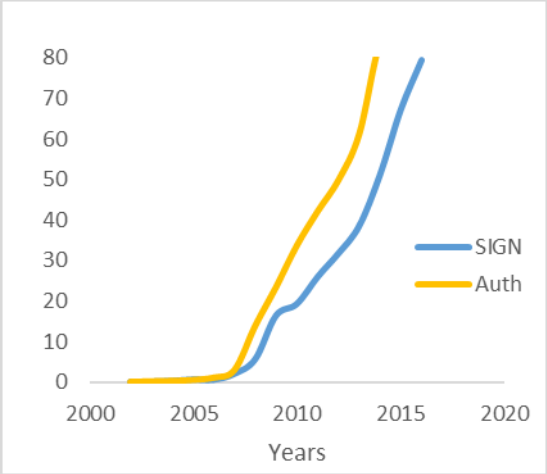

Fig. 5. Digital authentications and digital signatures in millions, compiled by the author with data from Sertifitseerimiskeskus (2017).

Obviously, this is only an indicator of abstract averages. In reality, some people are heavy users, some are occasional users, and some do not use the ID card at all electronically. In 2011, 86 percent of Estonian citizens had an ID card, but only 40 percent of those had used the card's digital features, either to authenticate their identity online or to give a digital signature [16]. This suggests that most citizens use the ID card offline, as a regular identity document.

Even though ownership of an ID card is mandatory, the law does not specify any penalties for not owning an ID card, and nobody has been penalized for not owning the card. Ownership of an ID card can make life more convenient. For example, the card can be used as a substitute for a passport when travelling within the European Union.

One recent development affecting the ID card arose as a result from of work by Czech computer scientists, who discovered a potential security flaw in the encryption of ID card in 2017 [20]. This created potential security risks for about 760 00 ID cards issued since 2014 once the research was made publicly available in October 2017. Essentially, the security flaw in encryption might allow digital identities to be captured through sophisticated and expensive use of cryptography. Estonia government closed down certificates of about 700 000 ID cards on November 3. Government agencies have worked out on potential fixes, but updating ID cards with new security certificates takes time as government IT systems are overcrowded. ID card owners can update their security certificates either online or offline until March 2018. The research findings have certainly generated some uncertainty about the reliability of the ID card. This has meant that use of mobile ID, which does not suffer from the potential security flaws, has increased.

In 2009, the Estonian government introduced the mobile phone-based identification method known as mobile ID. Mobile ID does not mean that people can carry out transactions on any mobile phone. Rather, it is a mobile phone-based identification method that is an alternative to the ID card, which requires a desktop or laptop computer. Mobile ID lets users conduct transactions in online environments using their smart phone as a substitute for an ID card.

The prerequisite for activating a mobile ID is the existence of an ID card. It also requires a special Mobile ID-compatible SIM card in the mobile phone, which is provided by all mobile operators in Estonia. It costs about twelve dollars to swap a regular SIM card for a Mobile ID-compatible SIM card. However, the use of Mobile ID has not become as widespread as the use of ID card. It is a newer innovation and is used primarily by early adopters. As of October 2012, 30,000 people had Mobile ID and about 80 percent of them actually used it. By October 2014, the number of users had reached 50,000 and 1.8 million transactions were conducted by Mobile ID per month. 75 percent of these transactions were banking transactions. The use of Mobile ID as a substitute for the ID card has been helped by the spread of smart phones and tablets. The ID card cannot be used with smart phones and tablets because they lack an ID card reader. However, both can use Mobile ID [16].

Over time, bank-provided online identification methods and the ID card have become a prerequisite for using most Estonian online government services and services provided by private companies. It is possible to speak of "forced digitalization," as many government services are not easily available without using an ID card or another method of online identification. Offline services are still provided but their users face significantly higher transaction costs than

users of online services. For instance, it has basically become very complicated to submit documents to the Estonian Business Registry without using an ID card, mobile ID or online channels (personal observation). However, some government officials responsible for the digitalization efforts in the Estonian government still point out that a significant number of online service users rely on the old, bank-based identification methods and do not use their ID cards online.

E. Public-Private Cooperation

In recent years, banks have actively supported the use of ID cards in internet banking by lowering the number of daily transactions that can be made using the old internet bank identification methods, and they have implemented price discrimination in transaction fees. In addition to the private sector, ID cards have become widely used by municipalities and other organizations. However, these are more recent developments that have built on the initial success of internet banking. From a long-term evolutionary perspective, internet banking was more fundamental in explaining the early emergence of e-government services than the ID card. Nevertheless, ID cards and mobile ID have helped spread the use of e-government services further.

The cooperation between banks and government is facilitated by the X-Road system, which forms the backbone of Estonian e-government. The X-Road system was outlined in a 2001 MSc thesis by Arne Asper, a programmer working for Cybernetica, a small Estonian IT firm that employed about 100 people. The distributed nature of X-Road makes it more secure than a centralized system, and allows it to exploit the benefits of what Isenberg termed the "stupid network" [17].

Figure 6 depicts the X-Road system. The X-Road can route queries from different databases in the public and private sector as demonstrated in the Figure 6. As systems are technologically different, they have to use adapters to send and receive information through X-Road. Each computer system uses its own secure server for encryption to protect sensitive data. Figure 6 demonstrates how public-sector registries, telecom and energy companies, banks, the government portal, and electronic ID infrastructure are all connected through a decentralized network.

Essentially, Cybernetica created a decentralized system for the Estonian government that is similar to what Kazaa did for file sharing and Skype for phone calls, exploiting the benefits of the internet as a distributed network. Most importantly, it has been cost-effective. Both Taavi Kotka, former Undersecretary for Government Information Technology Systems at the Ministry of Economic Affairs and Communications, and Oliver Väärtnõu, CEO of Cybernetica, confirm that the lifetime cost of X-Road thus far is no more than 67 million dollars, including maintenance, salaries, investments and other costs [18]. Usually, countries spend more than that a year for their e-government information systems, with more modest results.

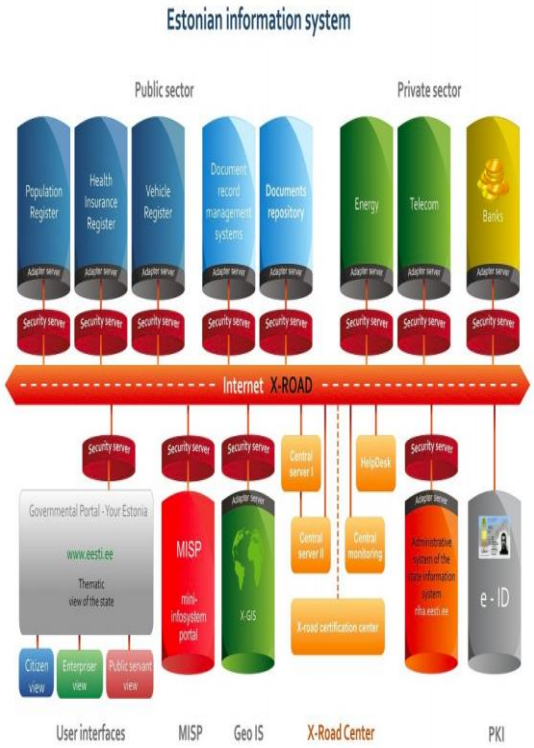

Fig. 6. Estonian Information System based on X-Road, adapted from the State Information Agency [16].

III. CONCLUSION AND IMPLICATIONS

The emergence of internet banking in 1996 directly benefited the provision of e-government services in Estonia. Internet banking provided a platform for e-government, and since 2000, Estonians have been able to file their taxes online, using the identification system offered by internet banking services. The use of internet banking as a platform shows that the decentralized approach to e-government service delivery provided incentives for self-interested agents, through the process of entrepreneurial discovery, to find innovative solutions for public-sector service delivery. The study on the use of government online services conducted in 2002 already indicated then that 48 percent of Estonian Internet users pay for e-government services through internet banking [19]. Other means of using e-government services were less exploited by the public.

Hence, the emergence of government online services did not result from a top-down centralized approach. Rather, it was based on a decentralized approach where some agencies were eager to launch new services while others were not. Some were keener to exploit online identification methods and the opportunities offered by the internet banking platform in the early years, which was further supported by the emergence

of the X-Road system. New services were provided by pioneering policy entrepreneurs, and some of them turned out to be successful. More online services in both the private and public sector created additional reasons for and familiarity in using the e-government services. It must be emphasized that the X-Road connected private-sector agents such as banks with government databases after an initial period of cooperation, which made it possible for both sectors to cooperate further and offer even more sophisticated services online.

The main implications of this research are that public goods can be delivered in cooperation with the private sector, and that it is important to facilitate entrepreneurial discovery processes in both the public and private sectors. Technological change is rapid, and it is impossible to forecast technological trends accurately. Hence, when designing government services, having an institutional design that facilitates flexibility, agility, and entrepreneurial discovery is fundamental. Instead of building new platforms, governments should leverage existing platforms, whether private or public, while of course managing potential risks such as technological lock-in and rent-seeking.

Furthermore, institutional complexity, policy heterogeneity, path-dependence and unintended consequences suggest that choices in digital governance are not binary. As Ostrom has demonstrated there are alternative mechanisms for governance than simplistic market versus government dichotomy would suggest [21]. Governance cannot be seen through black and white categories but should be analyzed as a spectrum with different degrees of grey.

Internet banking and tax authority essentially engaged in a coproduction of public services. However, coproduction can take place with multiple actors as private companies, governments, communities, non-governmental organizations and individuals can all contribute to co-production of public services. Elinor Ostrom already observed in 1972 that police agencies had different levels of effectiveness depending on the attitude of the citizens involved [22]. Citizens cooperation with law enforcement led to better public service in the form of policing. The value of a public service does not depend only on the provider, but is the result of interaction of providers and consumers.

Linders (2012) has pointed out how government as a platform novel uses of open government data can make coproduction of new public services possible [23]. Sometimes this approach is also seen as “Citizen Sourcing” and “Do it Yourself Government”. Government by making data and information available in digital environments can enhance its platform, create more valuable public goods and promote participation of citizens, firms and other interested parties in coproduction of public services. This network-based governance approach is very different from top-down hierarchy on the basis of what governments often operate. It is also different from New Public Management where government services are outsourced to private firms. Potentially, the coproduction approach might lead to higher degree of customization and empowerment in delivery of public services.

These implications are especially crucial for the industrial internet, “Industry 4.0,” or any other label used for the digital transformation of industry. Often, the transformation to industrial internet is discussed by emphasizing the need for new, top-down government programs and government subsidized investments. However, the future in this area is full of “unknown unknowns” and the potential for creating white elephants is enormous. However, institutional flexibility, technological agility, and network-based governance facilitating entrepreneurial discovery are essential in dealing with these uncertainties.

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