Social, Legal, and Technical Considerations for Machine Learning and Artificial Intelligence Systems in Government

Richard Dreyling[a], Eric Jackson[b], Tanel Tammet[c], Alena Labanava[d] and Ingrid Pappel[e]
Department of Software Science, School of Information Technologies, Tallinn University of Technology, Akadeemia Tee 15a, Tallinn, Estonia

Keywords: Artificial Intelligence, Machine Learning, Government Services, e-Government, e-Governance, AI Ethics, ML Ethics, AI Bias, ML Bias, Estonia.

Abstract: Expansion of technology has led to governments increasingly reconciling with advanced technologies like machine learning and artificial intelligence. Research has covered the ethical considerations of AI as well as legal and technical aspects of the operation of these systems within the framework of government. This research is an introduction to the topic in the Estonian context which uses a multidisciplinary inquiry based in the theoretical framework of technology adoption and getting citizens to use these services for their benefit. (Suggest that there are first results as well).

1 INTRODUCTION

The twenty-first century has brought with it the expansion of digital transformation in the public and private sectors. Information and communications technologies have been used by the public and private sectors to enhance efficiency and service delivery. Since the introduction of the microchip in 1971, the technological revolution has changed the way businesses conduct affairs as well as the ways in which governments handle governance tasks (Perez, 2002, 2010). The advent of the internet and the information technology boom has changed not only the ways that bureaucrats can govern, but also the items which must be governed. Expansion of technology provides new ways for businesses and citizens to push against laws in ways that governments could not have imagined at the advent of the microchip.

Governments have adopted E-government methodologies and platforms to be able to use information and communications technologies to streamline the business processes of government and deliver services to citizens in a more efficient manner. One country that has developed a reputation for the use of ICTs in service provision is Estonia. The small Baltic country has put a lot of effort into digitizing many government services. They offer many services online with the ability for citizens to accomplish the majority of their interactions with the government through authentication through various forms of electronic ID. The country has worked to minimize its digital divide, ranked as the twelfth most inclusive country in the world in a recent index (Economist Intelligence Unit, 2020). The combination of a tech savvy populace that also trusts its government has helped these efforts be successful. Since the 2000's Estonia has offered increasing government service offerings online with electronic identification (eID) and data exchange between government entities in a secure and tracked manner. They have even been successful in bringing e-Government to local municipalities and attracting people to virtual residency through their e-Residency program (Pappel et. al., 2015) (Kimmo et. al., 2018).

The expansion of computing power since the early 2010s, driven by graphics processing units has allowed for the expansion of artificial intelligence and

[a] https://orcid.org/0000-0001-7269-6236
[b] https://orcid.org/0000-0003-3726-5814
[c] https://orcid.org/0000-0003-4414-3874
[d] https://orcid.org/0000-0001-6318-7704
[e] https://orcid.org/0000-0002-5148-9841

Dreyling, R., Jackson, E., Tammet, T., Labanava, A. and Pappel, I.
Social, Legal, and Technical Considerations for Machine Learning and Artificial Intelligence Systems in Government.
DOI: 10.5220/0010452907010708
In *Proceedings of the 23rd International Conference on Enterprise Information Systems (ICEIS 2021) - Volume 1*, pages 701-708
ISBN: 978-989-758-509-8

machine learning research. Governments across the world have begun to use AI and ML in the conduct of government business and governance to try to better deliver services to citizens and in some cases control them.

However, Estonia would like to go further in using technology to help make life better for its citizens. In March of 2020, the Chief Technology Officer of Estonia launched a Next Generation Digital State Architecture Vision Paper. In this document the CTO discusses the concept of AI enabled virtual assistants to help achieve easier access to government services (Vaher, 2020). In Estonia, the public sector has a history of cooperating with academia in the country to ensure that the public officials were following the best available science at the time. Because of this cooperation, the research began after the release of the paper to investigate and support the topics laid out by the CTO through academic research.

This introductory research seeks to find the answer to the main research question that asks, "How can virtual assistant systems affect eGovernance services in Estonia?" This multidisciplinary paper will address the ways in which virtual assistant systems can enable government services in Estonia, what particular challenges are inherent to the general practice of using AI and machine learning in government and the specific case. This paper seeks to introduce this research topic as well as formalize the research gaps involved and lay out a roadmap and preliminary results regarding automation of government services and enablement through Next Generation Digital Government Architecture (NGDA) initiative. This paper will be an overview of the challenges that AI and ML enabled programs in government face from a legal, technical, and social perspective and how stakeholders in current active pilot programs in Estonia intend to contend with these challenges.

2 STATE OF THE ART

2.1 Introduction to Estonian e-Government Systems

The Estonian government has used technology as a way to ameliorate the issues caused by having a small population from which they can hire government employees. The Estonian government now has almost all services able to be completed by eID validated transactions online. The key building blocks necessary for this infrastructure from a technological perspective are the electronic ID and the Estonian implementation of a data exchange layer they call "X-Tee" or "X-Road" in English. All the official identification cards have a cryptographic chip capable of electronic authentication and giving signatures to documents. This enables use of a public key infrastructure (PKI) that enables encryption and digital signing of documents and transactions that are secure and legally binding. The X-Road acts as a data exchange layer. Developed in the early 2000's. X-Road uses security servers to authorize service clients and service providers. Any transaction, to include making changes to data or accessing data, registers with the time-stamping server and leaves a trace. Through this architecture, they ensure authentication, authorization, and accounting (Vaher, 2020). The time stamping server leaves a time hack on any transaction, which must be accompanied by an eID signature. Estonia ensured at the time that these innovations came into use that they included the social aspects, legal framework, and technical aspects of the solution all were primed in order to encourage use of the solution. The state subsidized the purchase of the ID cards containing the eID signing ability, as well as partnered with banks to make the IDs useful for logging into internet banking and completing transactions. The country also chose the best technical solution for eID, and has continued to handle any technical or security issues that have arisen from the non-compliance to best practices by contractors (Lips et. al., 2018). This enhances trust among the citizenry which is a likely factor in the strong adoption of the Estonian population of e-services.

Similar to other contexts, when a country is an early adopter of new technologies, technical debt and other phenomena can make further innovation a difficult task. The vision paper released by the Chief Technology Officer (CTO) of Estonia proposes methods to continue the path of innovation in the area of public sector service implementation. Some of these initiatives primarily focus on updating the technology currently in use in the Estonian eGovernance architecture. These include moving from monolithic applications toward an event driven microservices architecture. More than simply discussing some architectural changes, this paper outlines a vision that would have Estonians conducting government services through virtual assistants.

As outlined in the NGDA paper the uses for artificial intelligence and machine learning in government are called "Kratt." This name is based on

an entity from Estonian mythology (Scholl & Velsberg, 2020). KrattAI "is first a vision of how public services should digitally work in the age of artificial intelligence" (Sikkut et. al., 2020). When the Estonian Government refers to a "Kratt" this specifies a use of AI or ML, whereas the specific signifier "KrattAI" is the initiative that focuses on the aforementioned provision of government services that use the human computer interaction method of virtual assistants or chatbots (Scholl & Velsberg, 2020).

2.2 Technology Adoption Theories

One area of research has tried to codify the factors which can help to predict whether a citizen or employee will adopt a piece of technology. The area of technology adoption models began with the Theory of Reasoned Action (TRA) in 1975, which focused primarily on a social psychological explanation of people's perceptions and norms (Fishbein and Ajzen, 1975). Fishbein and Ajzen then expanded TRA into the Theory of Planned Behavior (TPB). From these, the research expanded into many different theories related to the adoption of technology in different contexts. Some of these include the Technology Acceptance Model (TAM), the expansions of TAM, including TAM2 and TAM3, as well as The Unified Theory of Acceptance and Use of Technology (UTAUT), and (UTAUT2). Each of these have various identified ontologies of factors which the researchers believed would affect technology adoption. Some of these theories have similarities that help to show the importance of factors that would encourage successful execution of projects containing machine learning and artificial intelligence. For example, in the Technology Acceptance Model's third version (TAM3) some of the determinants include the perceived ease of use of a piece of technology. These factors are "computer anxiety," "perceived enjoyment," "objective usability," as well as "perceived usefulness" from earlier TAM models (Venkatesh and Bala). In the Unified Theory of Acceptance and Use of Technology (UTAUT) the determinants of "effort expectancy," and "performance expectancy" are relevant to the specific challenges of AI and ML based systems in government, even though this model originally considered the corporate sphere (Venkatesh et al., 2003). These factors from a theoretical perspective can be considered proxies for the general concepts of effectiveness, usefulness, and usability. These concepts show the reasons that practitioners in the government would want to ensure that a tool that uses AI and ML are useful, effective, and usable by everyday citizens. In further research conducted on technology adoption shows trust to be an important factor in the use of e-government services (Grimsley & Meehan, 2007), (Colesca 2005, pp.39), (Carter & Bélanger, 2005). In addition, further research stated that trust is one of the most important factors related to "behaviour intention" (Alharbi et. al., 2016, pp. 1). For the solution to be successfully adopted in the populace, trust could be a key factor. The theories regarding technology adoption also apply to adoption of artificial intelligence and machine learning in government. Specific factors in the areas social, technical, and legal concerns will have an effect on the success of the Estonian Next Generation Digital Government Architecture (NGDGA) and its artificial intelligence related proposals

2.3 Social Perspective

Specific social challenges exist related to the effectiveness, usefulness, and usability of machine learning and artificial intelligence initiatives in government. One of the main challenges to AI and ML initiatives is that these will end up enhancing current disparities through the digital divide, and bias.

One issue that causes concerning social factors is research related to bias in AI and ML. A report called Government by Algorithm suggests that three findings became apparent in their investigation of the literature. They found that "the potential for machine learning to encode bias is significant" (Freeman Engstrom, et al., 2020). The researchers used the example of criminal risk assessment scores in the United States that have different rates of false positives for those of different ethnic groups (Freeman Engstrom, et al., 2020). The reasons for this are that AI can become biased due to programming or training, based on the data inputted to train the model, which can have the effect of making bias integral to the decision making of the AI (Mehr 2017)(Center for Public Impact, 2017). In addition, proposed methods of keeping machine learning fair can potentially not co-exist if these methods must have more than one definition of "fairness" (Freeman Engstrom, et al., 2020). If considering multiple groups of people who have multiple differences in race or gender it is impossible to ensure that all possible key performance metrics are equal across the groups (Freeman Engstrom, et al., 2020). The report also pointed out the necessity to consider how human and AI-assisted decisions correlate with one another because the bias in the AI and ML decisions comes

from the human decision making (Freeman Engstrom, et al., 2020).

The context of the above review of the literature was the United States. However, the European Parliamentary Research Service has also considered bias in these issues. They explain a resolution adopted by the European Parliament in 2019. The report states, "'any AI model deployed should have ethics by design'. The resolution specifically mentions four sets of issues in relation to the ethical discussion: 1) human-centric technology; 2) embedded values in technology – ethical-by-design; 3) decision-making – limits to the autonomy of artificial intelligence and robotics and 4) transparency, bias and explainability of algorithms (pp. 9). The European Parliament guidance on these systems recommends that any AI or ML based system does not perpetuate bias by ensuring ethical behavior integration in systems. When taken into account this in a practical sense puts the responsibility of making sure that bias and lack of ethics do not perpetuate current disparities.

2.4 Legal Considerations

Any Estonian implementation using AI for government purposes should comply with Estonian and European Law with regard to automated decision making and data protection. In the European Union at the moment there are competing existing frameworks for adopting AI. One assessment suggested that, "a common EU framework on ethics has the potential to bring the European Union €294.9 billion in additional GDP and 4.6 million additional jobs by 2030" (Evas, 2020 pp. 1). Beyond the general approach to data protection brought by the GDPR, Europe does not have specific legislation dictating how member states can implement AI in their countries. However, Estonia has a law that may impact the ability for AI to achieve what could be considered its full potential.

The Personal Data Protection act passed in 2018 has provisions that give specific purposes and criteria that need to be met for data processing which could mean that organizations other than the one which collected the data are unable to use AI or ML applications to provide services (Personal Data Protection Act, 2018). This law also provides specific criteria that must be met for automated decision making. According to some legal experts, one of these criteria means that the only two state registers which would qualify are the land register and company register because they are "considered having legal effect" (Kerikmäe & Pärn-Lee, 2020 pp. 6). In practice this means leads to the hypothesis that that any automated capability would be used more as a decision support system for a human decision maker. This law also has ramifications for technical best practices that will be discussed in the following section. In addition, the cross-border aspect of the data sovereignty requirements put in place by GDPR, the US CLOUD Act and the Estonian PDPA may make integration with the large virtual assistant providers complicated (Varughese, 2020).

2.5 Technical Concerns

The vision for a next generation digital government architecture must overcome technical challenges to ensure success. Although chatbots originated in private sector use cases, researchers have studied chatbots as a method of allowing consumers to directly speak through an AI mediated platform to government entities to assist in completing tasks (Akkaya & Krcmar, 2019) (Freeman Engstrom & Ho, 2020) (Androutsopoulou et. al., 2018) (Mehr, 2017). A chatbot is a system that has to accomplish several tasks. The chatbot must use natural language processing be able to interpret intent of a customer or citizen. After understanding intent, the bot should be able to complete the required tasks or connect the citizen with the relevant stakeholders to help assist them in completing the task. A chatbot may use supervised learning and when properly trained will improve its ability to operate the more it is used.

Data is a key factor in the accuracy of machine learning and artificial intelligence systems. Estonia has had over twenty years of e-government service experience. Because of this, they have accumulated massive amounts of data and have done a better job than some other countries of ensuring this data is machine readable (Scholl & Velsberg, 2020). The way the Estonian PDPA has been put into practice makes one legal challenge into a technical challenge. Estonia follows the "once only principle," which means that data is stored where it is collected and the citizen should not have to provide it to other government authorities. For example, if the police would like to know a person's address, they should query the population registry database. This leaves a signature through X-Road, the data exchange layer. When discussing an AI system though, even though the Estonian government may have more data available it is in various databases around the country. Researchers have attempted to ameliorate some of the organizational issues related to data, quality, and formatting in Estonia (Tepandi et. al., 2017). Because of this, there is no massive data pool from which the chatbots could be trained. This theoretically would make it difficult for the chatbot and virtual assistant

programs to be able to gain the accuracy necessary to achieve instant citizen uptake. Although, they could get better as time continues if the proper training and feedback mechanisms were implemented into the workflows of the system.

The NGDGA document elaborates on a vision in which chatbots would move beyond a single instance on a website toward a virtual assistant model. One of the options could be to integrate the Estonian government's hypothetical chatbot with the large virtual assistant providers to provide a more robust experience for the citizen (Vaher, 2020). This poses an issue because the Estonian language does not have support in the large virtual assistant providers or the existing translation APIs are not sufficient in quality. The language issue and the method of integration with virtual assistant providers are issues that must be solved.

A report regarding the United States Federal Government's adoption of AI and ML mentions the concept of internal and external competencies (Freeman Engstrom, et al., 2020). They found that some of the most successful implementations were created by employees of the government who were hired in a capacity such as lawyers and then developed their own machine learning and artificial intelligence capacity on their own time. They recommended to government procurement personnel in the US context to not simply outsource the development of AI and ML projects to private sector contractors. They found that the in-house developed solutions solved some of the issues with data access and source code access that outsourced projects experienced. In the United States the private sector has the advantage when it comes to AI and ML experience. However, Estonia has shown in recent years a propensity to use public private partnerships (PPP) to procure technological expertise that leads to successful projects when the need arises (Paide et. Al., 2018).

Harvard researchers identified five potential use cases for chatbots in the public sector which included, "(i) answering citizens' questions, com- plaints and inquiries through automated AI-based customer support systems, (ii) searching in documents (including legal ones) and providing guidelines to citizens on filling forms, (iii) getting citizens' input and routing them to the responsible public administration office, (iv) translating governmental information, and (v) drafting documents with answers to citizens' questions" (Mehr, 2017) (Androutsopoulou et. al., 2018). The vision put forth by the Estonian government goes further than this and calls for the virtual assistant technology to be able to help the citizen complete tasks (Vaher, 2020). The Mehr report quotes, CEO of Synthesis Corp. Ari Wallach, "'Imagine having direct and constant access to a high-level government concierge that is constantly learning and improving" (2017, pp. 10). This entails having a system that can constantly learn through supervised learning across data sets and stepping into territory which governments have not tread before at scale.

3 METHODOLOGY

To better investigate the current and future states of eGovernance with AI and ML enabled virtual assistants, qualitative methods were used. A review of recent literature served to get preliminary information. In addition, two workshops were conducted to elicit feedback from groups of experts who are stakeholders in the Estonian eGovernance context. Qualitative research has the inherent issue of bias. However, the workshop format and its semi-structured nature gives the participants the ability to express themselves freely and to communicate the way they perceive the issues at hand (Yin, 2014). Due to the early investigatory nature of the research at hand, the qualitative methods have the largest amount of flexibility to gather information to determine the future path of research. This methodology allows for the researcher to get the maximum amount of information from the experts in the field rather than have them conform to already existing theories and phenomena (Gioia et. al., 2012). This represents the best way to ensure that the researchers would not ask leading questions that bias responses when discussing the topics with experts and stakeholders in workshops. The workshops included stakeholders from the Nordic Institute for Interoperability Solutions (NIIS), stakeholders from the Ministry of Economic and Social Affairs of Estonia (MKM) as well as the software development company that is developing the KrattAI chatbot proof of concept (POC).

4 DISCUSSION AND RESULTS

Artificial Intelligence use can be considered to be controversial. Apart from the popular culture depictions of artificial intelligence as an antagonist force toward humanity, there exists a lot of literature on the topic. In section two, a review of some of the social, legal and technical concerns explored some of

the issues that a government implementation of AI and ML would have to avoid.

The workshop led to a discussion of these topics and how the Estonian government plans to ameliorate some of the issues presented in section two. The Estonian vision of may be considered one of the more recent developments in government services due to the initiation of the chatbot proof of concept to eventually directly provide services to citizens. Estonia is working right now to traverse the challenges and barriers which have been pointed out above. From the workshops with stakeholders the researcher gained insights into how the social. legal, and technical challenges have shaped the pilot programs in Estonia. Many of these are interrelated and will be presented in a manner which acknowledges this factor. These methods can inform the ways that other governments may shape their programs to help ameliorate some of the difficult points concerning AI and ML based initiatives.

From a social perspective, getting feedback from users both inside and outside of the government is important for the stakeholders in the various AI and ML programs. This concerns the theoretical grounding of technology adoption in a practical manner. One thing that a stakeholder observed was that though the team tried their best to make the instructions and all relevant materials in as clear language as possible, they got the feedback that some of the directions were too complex for those not already embedded in the IT world. This allowed them to ensure that by the time the services roll out to citizens and ordinary government workers, the likelihood of adoption will increase because they can iterate until usability has increased. They look at usability not only of the end user but of all the stakeholders in the chain who will be using

During the discussions, stakeholders acknowledged the potential for machine learning and artificial intelligence derived bias. However, they pointed out that the Estonian government has signed onto and helped shape the European Parliament's suggestions relating to ethical AI and controls against bias. And in the areas in which there are no standards that are universally accepted, the people in the Estonian government who manage AI suggest them to governing bodies. This helped to shape the way the Estonian government set up the chatbot POC that is the initial step toward the KrattAI vision as well as other Kratts. They decided from the beginning that whenever an AI or ML enabled decision support system would have a decision point that directly affects a citizen's service provision, in accordance with the Estonian law on automation, that a human decisionmaker would be there to make the final decision in some cases. Kerikmäe & Pärn-Lee summarized the guidelines dictating the law in practice as follows, "Human interaction should take place only if the algorithm result turns out negative or if the subject of the administrative decision disputes" (2020 pp. 6). This still does not completely solve the issue of bias due to human decisionmakers over time causing the bias, but it does take steps toward preventing hardcoded bias. Deference of human decisionmakers to automated decision systems is another potential source of problems in this area (Freeman Engstrom, et al., 2020). The stakeholders in this situation use the predictive, prioritization, and optimization abilities from AI to help in areas that the citizen and the government benefit from, not as a punitive function like using AI imagery analysis to determine subsidy compliance based on whether farmers have mowed their land or not. Instead of fining a farmer based on the results, the government would contact the farmer to ask the situation. Sometimes the farmer would have mowed the farm earlier in the year or be ready to do it. This saves government resources from doing on the spot investigation of each farm and farmers appreciate the ability to discuss with officials (Scholl & Velsberg, 2020).

In addition, there are some useful capabilities inside the government which can use AI and automate items that have no decision impact on the citizen but increase the ability for government responsiveness to the citizen. An example of this is internal email forwarding. The Estonian government had a massive problem with citizens emailing officials, employees, or department email addresses requesting information on where to direct their inquiries. One stakeholder mentioned specifically that in addition to normal government duties, some employees had to handle over 1500 emails a day. Some departments have been able to institute decision engines that look for similar inquiries and send responses automatically. This is an example of a situation where the laws as currently written allow for automated decision making. The government also gets feedback from the citizen to see if this forwarding solved their issue. However, it must be mentioned that this process is done on a department-by-department basis and has not been implemented across the entire government.

The method of handling the chatbot inquiries in the absence of a united data pool is novel and also helps solve the issue of referring citizens to the right authorities. The design of the KrattAI chatbot POC is to have networks of many chatbots with their own knowledge which can speak to each other. They do

not store the data from the transaction. This way, when a citizen contacts the chatbot and asks a question, the chatbots can refer the citizen to the chatbot with the proper knowledge base. The KrattAI chatbot POC is not yet to the point of executing government transactions but the POC has proven that a network of chatbots can allow for the proper functioning to find the proper chatbot for a transaction. This method maintains the legal boundaries put into place by Estonia while effectively handling the technical concerns from not having large data pools with which they can train the NLP engines of the chatbots.

According to the workshop attendees, in agreement with the NGDA vision paper, there are changes in the current E-governance architecture are necessary to enable the vision of virtual assistant enabled services. One change that still must be made is moving X-Road from a synchronous communication mode to an asynchronous version of communication. This could include publish, subscribe messaging patterns. The CTO has called this change introducing X-Rooms. X-Rooms would allow more than one verified entity to be party to the communication being passed and not require that both entities be connected at the exact same time. This is key for the vision to be achieved with virtual assistant driven services.

With a PPP the Estonian authorities have managed design, code, and test a system that uses AI and ML for the benefit of the citizen while attempting manage the difficulty points of these types of projects. Limitations of the research are that the number of interactions with stakeholders were few. The projects are also not that far along. The specific partnership potential with public virtual assistant providers is not able to be discussed and legally very complex. Because of these legal complexities, the options for integration to make the chatbot POC able to use virtual assistant capabilities would be conjecture.

Future work will take a specific case for which the virtual assistant capability could be used, and follow the business processes as well as specific technical processes through to the end of the transaction. If possible, an artefact will be designed to help solve a technical issue pertinent to initiatives of similar purpose.

REFERENCES

Ajzen, I and Fishbein M., 1980. Understanding Attitudes and Predicting Social Behavior Englewood Cliffs, NJ: Prentice-Hall, Inc.

Ajzen, I., 1991 The Theory of Planned Behavior, Organizational Behavior and Human Decision Processes 50, pp. 179–211.

Ajzen, I., 2010. The Theory of Planned Behavior, http://www.people.umass.edu/aizen/tpb.html.

Akkaya, C. and Krcmar, H. 2019. Potential Use of Digital Assistants by Governments for Citizen Services: The Case of Germany. In Proceedings of dg.o 2019: *20th Annual International Conference on Digital Government Research*, dg.o 2019, June 18, 2019, Dubai, United Arab Emirates. ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3325112.3325241

Alharbi, N., Papadaki, M., & Dowland, P., 2016. The impact of security and its antecedents in behaviour intention of using E-Government services. *Behaviour & Information Technology,* 36(6), 620–636. doi:10.1080/0144929x.2016.1269198

Androutsopoulou, A., Karacapilidis, N., Loukis, E., & Charalabidis, Y. 2019. Transforming the communication between citizens and government through AI-guided chatbots. Gov. Inf. Q., 36, 358-367.

Carter, L., & Bélanger, F., 2005. The utilization of E-Government services: citizen trust, innovation and acceptance factors. Information Systems Journal, 15(1), 5–25. doi:10.1111/j.1365-2575.2005.00183.x

Centre for Public Impact, 2017. Destination unknown: Exploring the impact of Artificial Intelligence on Government. Retrieved from https://publicimpact.blob.core. windows.net/production/2017/09/Destination-Unknown-AI-and-government.pdf.

Colesca, S.,. 2009. Increasing e-trust: A solution to minimize risk in E-Government adoption. Journal of Applied Quantitative Methods. 4.

Economist Intelligence Unit. 2020. The inclusive Internet Index 2020. https://theinclusiveinternet.eiu.com/explore/countries/performance

Engstrom, D.F., Ho, D.E., Sharkey, C.M., Mariano-Florentino, C., 2020. Government by Algorithm: Artificial Intelligence in Federal Administrative Agencies: Report Submitted to the Administrative Conference of the United States.

Engstrom, David Freeman and Ho, Daniel E., 2020. Artificially Intelligent Government: A Review and Agenda (March 9, 2020). Big Data Law (Roland Vogl, ed., 2020, Forthcoming), Available at SSRN: https://ssrn.com/abstract=3551549

European Parliament resolution of 12 February 2019 on a comprehensive European industrial policy on artificial intelligence and robotics (2018/2088(INI)).

Evas, T., 2020. European framework on ethical aspects of artificial intelligence, robotics and related technologies. European added value assessment. European Parliamentary Research Service, European Value Added Unit.

Gioia, D. A., Corley, K. G., & Hamilton, A. L., 2012. Seeking Qualitative Rigor in Inductive Research. Organizational Research Methods, 16(1), 15-31. doi:10.1177/1094428112452151

Grimsley, M., & Meehan, A., 2007. E-Government

information systems: Evaluation-led design for public value and client trust. European Journal of Information Systems,16(2),134–148. doi:10.1057/palgrave.ejis.3000674

Kerikmäe, T., Pärn-Lee, E., 2020. Legal dilemmas of Estonian artificial intelligence strategy: in between of e-society and global race. AI & Soc. https://doi.org/10.1007/s00146-020-01009-8

Kimmo, M.; Pappel, I; Draheim, D., 2018. E-residency as a nation branding case. Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance, ICEGOV2018: 4 - 6 April 2018, Galway, Ireland. Ed. Kankanhalli, Atreyi; Ojo, Adegboyega; Soares, Delfina. New York, NY: ACM Press, 419−428. (ACM International Conference Proceedings Series).10.1145/3209415.3209447.

Lips, S., Pappel, I., Tsap, V., Draheim, D., 2018. Key factors in coping with large-scale security vulnerabilities in the eID field. Electronic Government and the Information Systems Perspective: *7th International Conference, EGOVIS 2018, Regensburg, Germany, September 3-5, 2018, Proceedings.* Ed. Kö, Andrea; Francesconi, Enrico. Cham: Springer Verlag, 60−70. (Lecture Notes in Computer Science; 11032).10.1007/978-3-319-98349-3_5.

Mehr, H. 2017. Artificial intelligence for citizen services and government. Cambridge, MA: Harvard Kennedy School, Ash Center for Democratic Governance And Innovation. Retrieved January 10, 2021, from https://ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf

Paide, K., Pappel, I., Vainsalu, H., & Draheim, D. (2018). On the Systematic Exploitation of the Estonian Data Exchange Layer X-Road for Strengthening Public-Private Partnerships. Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance - ICEGOV '18. doi:10.1145/3209415.3209441.

Pappel, I., Tsap, V., Draheim, D., 2020. The e-LocGov Model for Introducing e-Governance into Local Governments: an Estonian Case Study. IEEE Transactions on Emerging Topics in Computing. DOI: 10.1109/TETC.2019.2910199 [ilmumas].

Perez, C., 2002. *Technological Revolutions and Financial Capital*, Books, Edward Elgar Publishing, number 2640.

Perez, C., 2010 Technological Revolutions and Techno-economic paradigms. *Cambridge Journal of Economics,* Vol. 34, No.1, pp. 185-202

Personal Data Protection Act, (AKI). (Est). *2018*.

Scholl, R., Velsberg, O. 2020. AI FOR GOOD LIVE: How Estonia builds the next generation e-government with AI use cases. International Telecommunications Union. https://www.youtube.com/watch?v=O3jiLbYVLQU (Nov. 10, 2020)

Sikkut, S., Velsberg, O., Vaher, K. 2020. #KrattAi: The Next Stage of Digital Public Services in #Estonia, Vision and Concept.

Tepandi, J., Lauk, M., Linros, J., Raspel, P., Piho, G., Pappel, I., Draheim, D., 2017. The data quality framework for the Estonian public sector and its evaluation: establishing a systematic process-oriented viewpoint on cross-organizational data quality. In: Hameurlain, A.; et al. (Ed.). Transactions on Large-Scale Data- and Knowledge-Centered Systems XXXV (1−26). Berlin: Springer. (Lecture Notes in Computer Science; 10680).10.1007/978-3-662-56121-8_1.

Thong, James Y. L.; and Xu, X., 2016. Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead, *Journal of the Association for Information Systems*: Vol. 17: Iss. 5, Article 1. DOI: 10.17705/1jais.00428

Vaher, K. 2020. Next Generation Digital Government Architecture.

Varughese, B., 2020. Cross- border data transfer in the context of the GDPR and CLOUD Act. Tilburg Institute for Law, Technology, and Society (TILT) LLM. Law and Technology.

Venkatesh, V. & Bala, H. 2008. Technology Acceptance Model 3 and a Research Agenda on Interventions. Decision Sciences - DECISION SCI. 39. 273-315. 10.1111/j.1540-5915.2008.00192.x.

Venkatesh, V., Morris, M., Davis, G., & Davis. F., 2003. User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425. doi:10.2307/30036540

Venkatesh, V., Thong, J. Y. L.; and Xu, X. 2016. "Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead," Journal of the Association for Information Systems: Vol. 17: Iss. 5, Article 1. DOI: 10.17705/1jais.00428

Yin, R., 2014. Case Study Research: Design and Methods (5th ed.). Thousand Oaks, CA: Sage Publications, Inc.