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FEASIBILITY OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN ESTONIAN'S STATE BUDGET PLANNING

Master’s Thesis

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TALLINNA TEHNIKAÜLIKOOL
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TEHISINTELLEKTI TEHNOLOOGIATE TEOSTATAVUS EESTI RIIGIEELARVE PLANEERIMISEL

Magistritöö

Juhendaja: Richard Michael Dreyling III
M.S., Ph.D. kandidaat

Author’s Declaration of Originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

Nowadays, Artificial Intelligence is rapidly expanding across various industries. Both private and public sector organizations are investigating Artificial Intelligence capabilities seeking to improve the current processes and enhance efficiency. Although the Artificial Intelligence phenomenon is under significant consideration, there is little or no evaluation of how machine learning can be utilized in state budget planning.

The main objective of this study is to examine Artificial Intelligence feasibility and potential for state budget planning in Estonia. The study focuses on identifying Artificial Intelligence core advantages and risks. Within the scope of this research Artificial Intelligence regulatory framework, social readiness to accept the change as well as general implementation drivers and barriers were analyzed. The exploratory case study methodology was used to examine the phenomenon feasibility in Estonian state budget planning process. For answering research questions and composing conclusions a qualitative approach was selected. This study considered a Unified Theory of Acceptance and Use of Technology that enlightens machine learning feasibility in state budget planning. Empirical data collection was also an essential part of the research during which interviews with government officials and machine learning experts were conducted, additionally the survey among Estonia residents was distributed.

As a result of the study, the main aspects of the Artificial Intelligence implementation in state budget planning were assessed, and the prospect of the possible future study was prescribed.

Keywords: Artificial Intelligence, Public Sector, State Budget, Financial Planning and Analysis, Information Technology Management.

This thesis is written in English and is 63 pages long, including 5 chapters, 3 figures and 4 tables.

Annotatsioon

Tehisintellekti Tehnoloogiate Teostatavus Eesti Riigieelarve Planeerimisel

Tänapäeval tehisintellekt laieneb kiiresti erinevates tööstusharudes. Nii era- kui ka avaliku sektori organisatsioonid uurivad tehisintellekti võimalusi, et parandada praeguseid protsesse ja suurendada tõhusust. Kuigi tehisintellekti fenomen on väga populaarne, on olemas väga vähe hinnanguid selle kohta, kuidas saab seda riigieelarve planeerimisel kasutada.

Käesoleva töö põhieesmärk on uurida tehisintellekti teostatavust ja potentsiaali Eesti riigieelarve planeerimisel. Uuring keskendub tehisintellekti peamiste eeliste ja riskide väljaselgitamisele. Antud uurimistöö raames analüüsiti tehisintellekti reguleerivat raamistikku, sotsiaalset valmisolekut muutustega nõustuda ning üldiseid juurutamise tegureid ja takistusi. Tehisintellekti teostatavuse uurimiseks Eesti riigieelarve planeerimise protsessis kasutati juhtumiuuringu metoodikat. Uurimisküsimustele vastamiseks ja järelduste tegemiseks valiti kvalitatiivne lähenemine. Selles uuringus käsitleti tehnoloogia aktsepteerimise ja kasutamise ühtset teooriat, mis valgustab masinõppe teostatavust riigieelarve planeerimisel. Oluliseks osaks oli ka empiiriline andmete kogumine uuringus, mille käigus viidi läbi intervjuud riigiametnike ja tehisintellekti ekspertidega, lisaks tehti küsitlust Eesti elanike seas.

Uuringu tulemusena hinnati tehisintellekti rakendamise põhiaspekte riigieelarve planeerimisel ning määrati võimalikke tulevaste uuringute väljavaateid.

Märksõnad: Tehisintellekt, Avalik sektor, Riigieelarve, Finantsplaneerimine ja -analüüs, Infotehnoloogia juhtimine.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 63 leheküljel, 5 peatükki, 3 joonist, 4 tabelit.

List of Abbreviations and Terms

AI	*Artificial Intelligence*
FP&A	*Financial Planning and Analysis*
GDP	*Gross Domestic Product*
UTAUT	*Unified Theory of Acceptance and Use of Technology*
RQ	*Research Question*
IT	*Information Technology*
VAT	*Value Added Tax*
GDPR	*General Data Protection Regulation*
EU	*European Union*
EBS	*Estonian Business School*
TV	*Television*

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1. Introduction

1.1 Research Overview and Motivation

Nowadays with the rapid expansion of technology, digital transformation has become part of both public and private sectors (Dreyling, Jackson, Tammet, Labanava, Pappel, 2021, 1). It is believed that Artificial Intelligence (AI) has a huge potential to change our lives by improving, speeding up and optimizing processes (Fukas, 2022). AI successful utilization examples can be found in various fields via human job automation like customer service tasks, lead generation, controlling the quality and detecting fraud (Neumann, Guirguis, Steiner, 2022). It is considered that in a number of areas, AI can perform tasks as good as regular employees or even better, particularly when it comes to repeating, concrete tasks based on clear algorithms, for example examination of large numbers of documents (Laskowski, Tucci, 2023). AI tools are capable of operating quickly and with comparably few mistakes, thanks to the enormous data sets it can operate with, AI can also give businesses insights into their operations they might not have paid attention to, thus rapidly expanding population of generative AI tools are expected to be implemented in various fields (Laskowski, Tucci, 2023). Budgeting cannot be neglected in technological change, as it is one of the most important public sector and financial activities of the government (Buchanan, 2014; Dalton, 2013).

Mcnichol, Lav and Leachman (2015) define state budget as one of the core financial activities of the government planning the revenues and costs for both short and long term. Projecting the funds for the next couple of years enables the government to anticipate and respond to predictable changes. Knowing the cost of maintaining the current level of services beyond a single year gives the government a heads up when major cost increases are coming before it's too late to avoid a fiscal emergency. Authors also highlight that an accurately established state budget planning process reduces uncertainty about the future and improves a state's business climate.

Along with the rapid development of Artificial Intelligence, there is a lack of research focused on AI capabilities in budgeting and financial planning specifically. Before implementing new tools in Estonian state budget planning it is crucial to gain clear understanding on how to put them in work efficiently. Author's great interest for this study is to validate AI risks and returns in financial planning and analysis (FP&A), highlighting how the budgeting process can potentially benefit from the new developments, what are potential challenges, legislation freedom or limitation and

possible social reaction to change. In addition, another research motivation is the author's enthusiasm about budgeting and financial planning, as well as Artificial Intelligence fenomen. Working in corporate FP&A and taking part in AI implementation discussions, the author became concerned about how new technical solutions can potentially affect a state's outcome and if it might help the government to achieve its goal by efficient cost optimization and process improvements.

The core principle of this study is to gather empirical and secondary data, study existing AI integration cases in the public sector, identify AI advantages and disadvantages for state budget planning, examine existing AI regulatory framework, public awareness and overall readiness to accept AI integration. Author expects research findings to benefit future AI integration in the Estonian public sector and perhaps state budget planning.

1.2 Research Questions and Objectives

Estonia is known for proactively implementing e-governance approaches across different industries including the public sector, however there is not much research done in the field of AI implementation in financial activity of the country. This study is built around examining AI feasibility and potential for state budget planning in Estonia. Author expects this paper to help governmental institutions responsible for state financial management aiming to implement AI developments to gain a better understanding of how it will improve budgeting process and what are the risks that should be taken into consideration before making the ultimate decision. This work will help to develop a set of recommendations and improve AI implementation project management. To investigate the implementation reasonableness and benefits, an overall question was formed: *how can AI be implemented for state budget planning and what are the drivers and barriers of AI implementation in budgeting?* In order to answer that question, the three research questions below were drafted:

RQ1. What are the advantages and disadvantages of implementing AI in the public sector?

SQ1. How can the government benefit from implementing AI?

SQ2. What are the risks to consider when implementing AI?

In order to succeed in new technology implementation it is important to formulate what features will allow to solve current problems and what are potential negative side effects of it. Answering this question will allow the author to list AI capabilities relevant for state budget planning and potential challenges impacting the process at the national level that should be considered during implementation.

RQ2. What disclosing and educating procedures must be carried out among Estonian residents before implementing AI in the public sector?

The second question focuses on the importance of raising awareness and assessing social readiness for AI implementation. This question is of particular significance when implementing new technology in the public sector. Answering this question will allow the author to understand the current level of AI recognition among Estonian residents and potential reaction to change. Covering this aspect is important to support financial transparency of the country and general democracy principles.

RQ3. How does the regulatory framework in Estonia determine AI usage for the budgeting activities in government?

SQ1. What legal obstacles can limit AI use in state budget planning?

The third question examines the current AI regulatory framework that can potentially support or limit AI use in state budget planning. National legislation is the foundation for any authority activity that governmental organizations must follow, hence it is necessary to investigate the current framework under which the Ministries operate. Answering this question will allow the author to determine AI recognition from the legal perspective.

1.3 Research Methodology

Following the formulation of the research questions, a reasonable methodology was adopted. Analyzing feasibility of Artificial Intelligence in state budget planning requires empirical evidence to be collected, hence qualitative research methods were favored. The research involves identifying, assessing and explaining evidence through qualitative research methods culminating in exploratory case study.

Case study research method enables the author to take into account numerous confirmed proofs gathered from various sources (Verner and Abdullah, 2012). Yin (2002) also determined that case study allows the author to investigate occurrences within concrete context, taking into consideration multiple sources, like official documentation, past observations, surveys, interviews etc. This methodology facilitates a comprehensive investigation of a particular research domain, managing an in-depth inquiry of its complexity and nuances (Yin, 1984). Zainal (2007) also claims that this approach assists in the progress of inspecting exclusive circumstances and discloses the actual complexity of the case. The benefit of this method is its decency for unbiased, inclusive,

flexible research, that helps to identify trends and ensures conceptual viewpoints that can offer valuable direction for future inquiries (Ogawa & Malen, 1991). Given that the case study method exactly aligns with the objectives of the author's research and can be deemed the most reasonable approach.

Furthermore, the concept of UTAUT (Unified Theory of Acceptance and Use of Technology) is taken into consideration in assessing feasibility of AI technologies in state budget planning. Components described in the UTAUT are accounted for in the study when assessing AI potential in state budget planning.

Qualitative data gathering and evaluation methods contribute to this study. Author identified five core data processes to finalize consequential insights into the study. These are data collection, deconstructing, reconstructing, assessment and outlining conclusions. Data collection goal is to gather information from academic resources, interviews and a survey that further contributes to compiling baseline for research results. This stage is crucial, since research result quality depends on the quality of data collected. Data deconstructing purpose is to map out meaningful insights, structure and classify the evidence into sections. This stage represents primary work with collected evidence that is considered the foundation for further analysis. With data reconstruction recurring connections from different sources are consolidated to derive research findings. This core stage of research is important to determine main concepts to be used for summarizing results. Data assessment goal is to analyze the interactions between identified affiliations and draw up analytical conclusions. This stage is decisive for explaining the interconnections of the compiled evidence. With outlining conclusions the author determines analysis results to meet study objectives and answer research questions. This is the final stage of the study contributing to meaningful research insights and valuable guidance for potential future work.

Evidence used in the research is collected from a survey conducted among Estonian residents, interviews with Estonian experts from governmental organizations and other academic resources like organizational records, formal studies and other past learnings. A survey among Estonian residents was designed to assess public attitude towards AI integration in state budget planning, which was conducted in Google Forms. The survey was distributed via social media, author’s work channels, LinkedIn and friends. Non-probability sampling method was used to ensure a more diversified result. The survey involved people with different levels of education, age and sex. Total number of respondents is 104 and survey questions can be found in Appendix 3. Literature review involves such academic resources like books, articles, websites, journals, newspapers, theses, dissertations and other reference works. Interviews with experts were designed

considering research questions, objectives and goals. Author used Excel to link the experts' answers, identify similar patterns and classify recurring ideas. As a result of that interview mindmap, that can be found in Appendix 2, was drawn. Interview questions can be found in Appendix 2. Moreover, interviews were conducted in a flexible way (semi-structured) enabling experts to openly share various perspectives, provide fresh insights and relevant examples by their choice. Additional insights have been gathered via email. Interviews were carried out via Microsoft Teams with four Estonian experts from different organizations who have been in charge or participated in various AI related projects. The interviewees were conducted with a former member of the Ministry of Finance and current AI trainer in Estonian private organization, member of the Ministry of Justice, Estonian Information System Authority and Ministry of Economic Affairs and Communications.

Kristiina Tuisk, the former Adviser for the State Budget Department and Process Manager in the Cybersecurity Department who is currently working as an AI trainer in the company called “Productory”. She has been involved in the state budget planning process for almost 3 years when working in the Ministry of Finance. Moreover, currently she is giving lectures on the topic of AI utilization for process improvements for various stakeholders like EBS and Tallinn University of Applied Sciences.

Henrik Trasberg from the Ministry of Justice, was responsible for AI legislative developments and AI driven automations in the Estonian public sector also contributing in drafting EU AI Act ensuring that the document reflects Estonian interests. This made him a significant contributor in the study.

Kristel Kriisa is AI Project Manager from the Estonian Information System Authority, was responsible for integration of AI in several Estonian public sector services. Additionally, she was involved in raising AI awareness by conducting academic seminars to different stakeholders in Estonia.

Sofia Paes from the Ministry of Economic Affairs and Communications, was responsible for overall digitization projects of the public sector in Estonia. Her role as a Data Policy Advisor determined her contribution to this study.

Eneken Lipp is Head of State Budget Development Department in the Ministry of Finance. She has been responsible for coordinating developments in the field of fiscal policy and public financial management, supporting State Agencies with IT systems, counseling and managing training. Author received her feedback via email.

1.4 Thesis Outline

In order to guarantee a comprehensible presentation of the information in this study, the author structures the research paper in five main chapters, consisting of subchapters. The first chapter includes introduction to the research together with the author's motivation towards the chosen topic, followed by the research objectives and the research questions justification. The second chapter is dedicated to literature review of the Artificial Intelligence concept covering the main aspects of machine learning integration in the public sector. The second chapter focuses particularly on the current and potential role of AI in the public sector, its advantages, successful use cases and high probability challenges. Additionally, it addresses the socio-educational paradigms of AI integration, international regulation, as well as general AI potential in state budget planning specifically. The third chapter observes the case of Estonia, covering the Estonian state budget planning process and national legislation. The fourth chapter represents the research findings examining AI potential in state budget planning within Estonian context based on empirical data collected. This chapter focuses on the analysis and outcome of the research conducted by the author followed by discussion and study limitations. The last chapter explains the study results ultimately leading to research conclusions.

2. Literature Review

2.1 Transforming Governance: The Role of AI in Public Sector

Artificial Intelligence (AI) is transforming habitual ways of life across the globe and setting new trends in various professional fields. The way industries and societies interact with each other is anticipated to change significantly compared to what humans are used to from the past experience (Wang, Siau, 2019, 72). The realization of the AI within the private segment organizations significantly impacted the public sector. Public sector institutions are progressively researching the potential of utilizing machine learning, automation solutions and AI capabilities to result in accurate service arrangement and produce efficient outcomes in line with modern trends (Mikhaylov, Esteve, Campion, 2018). It is generally considered that Artificial Intelligence can make human lives easier by encouraging machines to act consistently and perform numerous human-like assignments (Maheshwari, 2023). Mehr (2017, 10) also claims that AI has a huge potential to positively impact government and citizens interaction, strongly increasing government efficiency through enabling custom and relatively cheap education procedures, detecting fraud and corruption, enhancing cybersecurity with constant monitoring, improving crime reporting, targeting social services interruptions and informing about their repairs.

That's the reason why Artificial Intelligence is being under consideration as a possible e-governance solution to improve the public sector services and administration efficiency. Public sector is one of the fundamental parts of the world and a single state structure which plays a crucial role in establishing the living standards, country economy, society's well-being and overall development of the state. Therefore, when studying the possibilities of new technologies in this segment, it is necessary to evaluate all the positive and negative factors even more carefully.

2.2 Unlocking Potential: AI Advantages for Public Administration

Artificial Intelligence is undoubtedly one of the most attractive, relevant and inquisitive topics of today that is being on the main headlines due to its wide range of features. This chapter is dedicated to identifying the advantages of AI and highlighting how the public sector potentially benefits from AI based technologies.

Support Decision Making Process

Managing the decisions is a principal unit of the public sector focused on reacting to the needs of the individuals and giving productive and socially mindful administration (Bercu, 2013). There are many technical capabilities of AI, however Yfantis and Ntalianis (2020, 79) claim that the most important is to learn the behavior patterns based on collected evidence and advance smart decision making through that. Davenport (2020) also proves that AI is good at controlling expansive amounts of data and providing different scenarios based on that. Furthermore, Kumar (2019) also highlights that utilizing AI innovations enables machines to find resolutions and carry out decision activities quicker than a human ignoring the emotional aspect of the question which often interferes with the decision making process and produces errors. AI technologies are actively boosting and broadening decision support by coordinating data delivery, evaluating existing tendencies, doing forecasts, improving data consistency, classifying uncertainty, acknowledging the user's data needs, compiling information in the most convenient forms, and prompting courses of action (Phillips-Wren, Jain, 2006). Valle-Cruz, Fernandez-Cortez and Gil-Garcia (2022, 12) highlight that AI has a huge potential to support governmental officials in the decision making process. According to the authors, AI has the capacity to be involved in public sector decision-making procedures and potential to both improve and speed up this process.

Human Error Reduction

As mentioned already, decision-making processes performed by an individual have a high risk of human error, due to conflict of interest, personal preference and emotional factors. This risk is not only relevant for decision-making processes, but it can also occur in any part of public sector administration operations. Maheshwari (2023) claims that if AI-enabled technologies are modified accurately, they make zero mistakes, since these tools are based on predictive examination excluding potential errors. Mehr (2017, 4) also confirms that AI is good at predictable scenarios, working with large datasets, summarizing and aggregating different types of data. These are the areas of individual responsibility with the high risk of human error. AI potential in the USA and Peru medical sector was researched by Paredes (2018). Results show that with the use of AI numerous medical human errors can be avoided, since most of them are certified and well-researched, thus new technologies can predict risky cases and prevent them from happening. Miyamoto and Takahashi (2013) highlight the necessity of mastering the internal mental processes behind human errors, indicating that AI has a huge potential to scale down human errors by establishing a database for their reduction. AI solutions generate results with less error risk, need relatively less effort to design outcomes that differ only slightly from the human generated ones (Schneider, 2020, 431). Consequently, AI enables efficient time management and resource allocation supporting

accurate results avoiding human errors.

Expanded Availability of Services

Another recognized AI advantage is its permanent availability also supported by trustworthiness (Chowdhury, 2012, 6), since unlike people it can operate more tirelessly and systematically. One of the successful examples of availability as an advantage of AI in the public sector is "Bürokratt". Estonian Artificial Intelligence based solution "Bürokratt" is a virtual assistant that enables Estonians to use public and information services through voice-based communication, providing reliable answers on any topic whenever it is needed (Riigi Infosüsteemi Amet, 2024). Maheshwari (2023) also points out that AI tools can be constantly productive, functioning longer hours than people are capable of working. Through the 24/7 availability of AI technologies, public sector services become also permanently available for the end users ensuring emergency response (Mehr, 2017, 1) and overall efficient public service delivery.

Enhanced Automation

Badet (2021, 2452) claims that automation is a huge AI advantage that supports the formation of new or more complex forms of existing work that will increase productivity of the public sector. AI automation can lead to more efficient resource allocation, enabling administrative problem solving face-to-face with citizens, making people feel more involved in the public sector (Mehr, 2017, 4). Additionally, other studies confirm that Artificial Intelligence can replicate and complement existing analytical techniques, distribute resources, provide guidelines and allocation criteria to achieve multiple goals (Valle-Cruz, Fernandez-Cortez, Gil-Garcia, 2022, 12). Eggers, Schatsky and Viechnicki (2017) from Deloitte University highlight that tasks automation enabled by AI can save around 1.2 billion federal hours, with an estimated savings of $41.1 billion annually. This proves that automation is a powerful AI advantage which can play a crucial role in public service positive progression.

Improved Data Governance

Additionally, the public sector can potentially benefit from Artificial Intelligence through improved data processes. McGregor and Hostetler (2023) studied the process of data-centric governance facilitated by AI, concluding that the offered approach decreases implementation time, increases resolution quality, minimizes deployment risks, and guarantees compliance with governance requirements in terms of data. This is achievable thanks to AI frameworks that can operate at boundless scale and speed. McGregor and Hostetler (2023, 21) sum up that with strong data-centric administration combined with AI capabilities public sector organizations can ensure longer valued data lifecycle and decrease data vulnerabilities.

2.3 Empowering Governance: Use Cases of AI in Public Sector

In addition to theoretical and technically proven advantages of Artificial Intelligence, there are already existing use cases of new technologies in the public sector. Estonia is one of the examples where AI is being actively studied and tested in public sector implementation.

Below provided list of Estonian existing AI usage examples are determined in AI - "kratt" Strategy (2020) and summarized with paraphrasing by author:

- Detecting anomalies and incidents on the traffic of the X-road.
- Predictive analytics is used for decision making when sending the police for traffic regulation.
- Matching job seekers with open positions used by The Estonian Unemployment Insurance Fund.
- Detecting land mowing used by Estonian Agricultural Registers and Information Board.

Misuraca, Noordt, Boukli (2020, 94) researched AI implementations within the public sector of the European Union countries. Results show that the highest number of AI driven solutions occurred in the Netherlands (20 initiatives), followed by Belgium (19 initiatives). Collected statistics show that most of the currently used AI-driven technologies are based on Natural Language Processing technology, such as chatbots or speech recognition, additionally Pattern recognition and Image processing. Misuraca, Noordt, Boukli (2020, 95) conclude that the most common use of AI technologies in the EU is related to automatic text or image recognition in order to provide more insights for further prognosis.

Below is the list of successful AI use cases in public sector around the world:

- USA program "Secure Flight" is a AI-based passenger prescreening system that improves security checks by recognizing low and high-risk customers before they arrive at the airport by matching their names against reliable traveler lists (Homeland Security, 2023).
- The Patient Admission and Prediction Tool (Australia) predicts the expected daily patient load in the hospitals as well as their medical emergency, case complexity, and how many will be admitted and discharged using AI (CSIRO, 2010). This tool

enables Australian medical institutions to plan their staff workload, decrease waiting lists and ensure efficient treatment.

- Spark tool (Australia) uses AI to foresee forest fire spread risk. This framework ensures sufficient planning of firefighting capability and efficient action plan to save properties, peoples and animals lives (CSIRO, 2021).
- Similarly to Estonia AI systems are being used to manage traffic controls in Singapore (Torque, 2018). Also, AI helps to identify theft locations on the road to timely direct police resources in China (Bianji, 2017).
- "Alex" is the "Bürokratt" analogue used by the Australian Tax Office. Alex is a chatbot enabling clients to interact with the Tax Office online and answer taxpayer queries. "Alex" has a 75–90% resolution percentage and as a result of that Australian Tax Office telephone call demand dropped by 7% (Barbaschow, 2019).
- The USA Securities and Exchange Commission uses AI to determine financial fraud and disclose cautious share trading (Engstrom et al, 2020, 23). Australia's Tax Office also uses AI enabled evaluation to algorithmically detect tax and social security fraud risk (Henman, 2020, 212).
- The USA Food and Drug Administration implements AI technologies to assess new medications, by analyzing patterns in disclosed adverse reactions ensuring public protection and medical safety (Engstrom et al, 2020, 53).

2.4 Unveiling Obstacles: AI Challenges in Public Sector

Aside from advantages, new technologies are always accompanied by risks and limited capacity that must be taken into account during the evaluation and further implementation phases. Artificial Intelligence is no exception, thus when studying AI potential in the public sector work, it is also necessary to carry out accurate research about its potential weaknesses, limitations and high impact risks. Learning to identify and address negative side impacts of machine learning activities is essential to move forward the security, high quality and accuracy of independent frameworks, such as AI (Saisubramanian, Zilberstein, Kamar, 2020, 1).

Creativity Deficit

Machines are good at performing tasks based on predefined logic, data algorithms and past experiences, however they lack outside of box thinking (Kumar, 2019). This leads to immediate concern about the competence of the AI tools to generalize to situations that were not preliminary described in the existing dataset (Chowdhury, Sadek, 2012, 7). Chowdhury and Sadek (2012, 7) propose that this can be solved by combining and integrating more than one AI solution into a hybrid tool or merging AI with more

traditional methods, such as human generated approaches. Consequently, it means that AI technologies cannot be treated as fully autonomous systems and they often require human assistance and controls. Hagendorff and Wezel (2019, 359) also state that AI is still in its infancy and even most complex neural networks with more than a billion interconnections represent only a small part of brain tissue, thus these systems cannot fully replicate human creativity.

High Costs

In the rapidly changing nowadays environment AI is apparently in the process of modification and improvement on a daily basis. As a result of that IT tools working on the basis of the AI must be accurately adapted to the processes to operate in line with the expected demands, however maintenance of complex tools is usually quite expensive (Kumar, 2019). Despite the fact that such expenses are usually considered to pay off in the future, it is difficult to accurately predict when and if it is going to happen, leading to high financial risks for the public sector organizations.

Lack of Ethics

The counter argument for the Artificial Intelligence automation is a challenge related to the potential liability and ethics. Chowdhury and Sadek (2012, 8) question who will be responsible for the AI mistake from an ethical perspective. Additionally, it must be pointed out that technical communities are recognized for the intersection of computer science, it should however be mentioned that the majority of software engineers have purely technical training and not enough ethics competency and social knowledge of the problem they are often solving (Campolo et al, 2017, 2).

Optimality Rate Risk

Chowdhury and Sadek (2012, 7) claim that AI can never guarantee to hit the most optimal solution for the stated problem. Authors highlight that when using AI-based techniques, it is often complicated to gain valid insight into the question and the nature of the output, compared to mathematical programming for example, thus the inability to promptly do sensitivity validation is a crucial example of AI shortcoming. Nevertheless, Chowdhury and Sadek (2012, 7) agree that a low optimality solution is still better than no solution at all.

Unemployment Risk

Furthermore, it is often considered that Artificial Intelligence can provoke an increase in unemployment level, due to the risk of robots replacing humans at work. The demand for some positions has decreased with the introduction of AI (Brynjolfsson, Mitchell, 2017, 1533). In the process of researching AI implementation challenges in the public

sector of Pakistan, Bibi (2019, 120) mentions that there is a fear of job loss as a side effect of AI among organizations. However, Maity (2022, 3257) claims that unemployment risk will be addressed by changing the paradigm, shifting the form of employment opportunities and would generate new careers, supporting the productivity of the employees and produce innovative economic scopes. It is worth recognizing that the risk of unemployment with the introduction of AI really exists, however, there are already known ways to address these disadvantages in public sector organizations.

Incomplete Legal Regulations

The experts and scientific community predict that with the rapid growth of investments in AI and the expansion of the scope of their application, AI legal regulation becomes challenging (Khisamova, Begishev, 2019). Atabekov (2023) studied AI legal status and public sector implementation in multiple Romano-Germanic countries (Germany, France, the Netherlands, the Russian Federation, Estonia), Anglo-Saxon countries (USA, Great Britain, New Zealand, Canada, and Singapore), Israel and the UAE. His study shows that most of the countries under research paper investigation are taking steps to establish national strategies in the field of AI, however there is still a large gap in the readiness to regulate AI across different countries. Atabekov (2023, 14) admits that AI legal regulation is still a challenge, accordingly there is a risk of AI going beyond the scope of existing law, which can create compliance risks for the public sector.

2.5 Socio-Educational Paradigms: Preparing for AI Integration

Alshahrani, Dennehy and Mäntymäki (2022, 9) declare key things to consider for successful integration of AI into existing public sector processes, such as balance between social and technical elements and the importance of taking into account unique shades of every public sector service. When implementing AI in the public sector it is essential to take into account that each country is structured differently, thus potential challenges can vary. However, other countries' experience may be a useful and relevant baseline for other countries' initiatives.

Nazir and Gul (2023) indicate main potential machine learning adoption challenges based on the example of Pakistan, below is the list of evidence from their work summarized with paraphrasing by author:

- Regulation limitations and policy drafting.
- Data management and cyber security risks.

- Organizational adoption issues, ethical and social acceptability.
- Infrastructure development issues and implementation challenges.
- Management compatibility and lack of essential skill set.

New technologies always require preliminary groundwork and education not only among those who deploy AI but also among end users of the service for their most efficient utilization. Ignoring the end user training aspect, the risk of encountering the shortcomings of AI solutions, ethical surprises and other social impacts increases greatly, thus it is crucial to provide all the stakeholders with the proper guidance and accurate evaluation (Butterworth, 2018). Furthermore, it is important to highlight that AI implementation means not only benefiting from its advantages and making residents life easier, but it comes together with the additional work on the necessity of understanding end user rights, personal data compliance and overall service security.

As reported by the United Nations in 2018, Estonia is on the 16th place in the e-government development statistics, and on the 27th in the e-participation statistics out of 193 studied countries (Fundamental Rights Agency, 2020, 14). The European Union Agency for Fundamental Rights (2020) announced a country report about the initial mapping of human rights and information society in Estonia. They specifically targeted the potential issues related to AI in information society analyzing AI-driven solutions from a human right perspective and corresponding public education.

The European Union Agency for Fundamental Rights (2020, 13) report suggests the main e-governance standards with the introduction of AI to share with the stakeholders, below is the list of principles from the report summarized with paraphrasing by author:

- AI impact on human rights, ensuring that people know that AI decisions should minimize intolerance and segregation, while maintaining the right to receive public services smoothly and conveniently.
- The use of personal information, ensuring that residents know how to manage which government services use their personal data, how it was collected, how it is protected and how they can agree to process it or submit a protest to its automated execution.
- Rights protection, securing individuals know how to judge the protection of their rights when using e-services provided by the state.

Chalke, McEvoy and McLeod-McKay (2021, 46) studied social challenges related to AI implementation in the public sector. They concluded that comprehensive open instruction is required to grant individuals a genuine awareness of what can be done

through AI to advance more arguments around what rights and interfaces are impacted by the innovation, and how people's digital information should be addressed. The authors claim that involving residents in exploring what AI can do for the government is crucial for establishment of an informed and conscious society. They especially highlight the importance of incorporating assorted points of view around how current standards affect individuals and support their digital literacy. They agree that with the expansion of AI the public will demand more clarification about social and financial effects of AI, thus the government should be ready to answer all questions in advance. Digital literacy and prompt updates on Artificial Intelligence use in the public sector will provide people with the tools to make attentive decisions that express their real interests with respect to technology, as well as support general democracy principles such as government transparency and public engagement in e-government solutions. Authors propose that public education can be distributed through various channels such as: media, civil society organizations and academic communities.

Additionally, social readiness to accept new technology is explained in the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT verifies the core criterias impacting users acceptance and recognition of new technologies when implementing them (Venkatesh et al, 2003). In UTAUT Venkatesh, Morris, and Davis (2003) solely highlight the influence of managers and leadership responsible for the change. They assert the impact of knowledge, gender, age and willingness to use, as well as anticipation of effort outcome, perceived ease, social persuasion and supportive environment.

2.6 Navigating AI Regulations: Existing Legal Frameworks

The topic about the importance of Artificial Intelligence regulation became relevant in 2016 and although AI was commonly considered to be a subject of Information Technology study field, interest in its regulation has been increasing by other sectors, such as Law, Business Administration, and Philosophy since then (Gomes Rêgo de Almeida et al, 2021). Since 2017, the European Union (EU) has been conducting scientific work to study the issues of regulating the use of AI and forming harmonized legal framework for the digital market functions which can be expressed in different requirements for products and services in the field of AI in EU countries, including their use, responsibility in this area, supervision by government authorities to reduce legal uncertainty for both providers and users systems equipped with AI (Taran, 2023). As of February 2024 EU has an official AI Act proposal addressing the risks of AI in Europe which was approved by the Council of EU Ministers (Mantrali, Papachristodoulou,

2024). This Act was created taking into account past works of experts in the field of EU legislation.

Declaration of Cooperation in the field of AI from April 10, 2018 was signed by representatives of 25 European countries, including the UK and Norway. According to the document, the participating states are addressing the challenges of developing AI technology, innovative business models, accelerating economic growth, creating new highly qualified professions and transformation of the labor market, creating a legal and technical basis for the use of appropriate technology, as well as conducting scientific research in this area, the creation of scientific centers and exchange national experience (European Commission, 2018).

One of the leading documents in the field of AI regulation in the EU is the Strategic Program "Digital Europe" for 2021-2027, which addresses the development of AI and robotics within the EU (European Commission, 2021). The goal of the program is to construct and improve center Artificial Intelligence capacities and information within the Union, along with building up and reinforcing quality of information assets, corresponding network instruments, while ensuring a human-centric and comprehensive approach that regards Union values.

Resolution of the European Parliament for the European Commission named "Civil Law Rules on Robotics" dated February 16, 2017 is another important legal basis for regulating relations in the field of creation, use and implementation of AI (Official Journal of the European Union, 2017). It is a comprehensive document that examines complex AI systems recognition issues as electronic individuals, highlighting the necessity to establish accurate definitions for these systems. Additionally, it creates the preconditions for holding robots liable in the event of damage and discusses the basic principles of AI development for civilian use, ethical principles, standardization and safety of such devices, use of autonomous vehicles (drones, robots) etc.

Communication report "Artificial Intelligence for Europe" dated April 25, 2018 contains examples of the use of AI in various fields of the EU (European Commission, 2018). The purpose of the document is the technological and industrial use of AI in the private and public sector, carrying out preparatory work for socio-economic changes in the field of education and labor, development of ethical and legal framework in the Union based on the values enshrined in the legal framework of the EU. Additionally, the document examines the competitive position of the EU among countries such as the USA and China, which are actively investing in the field of AI.

Ethics guidelines for trustworthy AI published on 8 April 2019 by the European Commission is the basis for the development, implementation and use of AI technology that will be characterized as trustworthy and reliable (European Commission, 2019). The document sets out the main ethical principles such as respect for human autonomy, prevention of harm, fairness and explainability. The Ethics Guide for Trustworthy Artificial Intelligence outlines seven core requirements that must be performed in relation to the AI system: human control, supervision, technical safety, privacy, confidentiality and data management, transparency, no discrimination and justice, social and environmental well-being and accountability.

Report "Policy and Investment Recommendations for Trustworthy Artificial Intelligence" published by European Commission on 26 June 2019 ensures that people and society as a whole benefit from AI implementations. In addition to that, the report focuses on supporting AI research demand in the private and public sector, when working with data (including accessibility issues), in the areas of education, management and regulation, fund creation and investment (European Commission, 2019).

Cybersecurity topic is extremely important for the EU, in this regard, EU Regulation 2019/881 of the European Parliament and the Council on ENISA (EU Cybersecurity Agency) and certification for cybersecurity of information and communication technologies of April 17, 2019 play a significant role, which repeals Regulation 526/2013 (Cybersecurity Law). This Regulation will apply to AI, since the use of this technology may be associated with a high level risk in the field of cybersecurity.

Furthermore, non EU related international organizations are also actively managing AI policies and there is already existing international AI regulation workings, such as:

- Recommendation of the Council on Artificial Intelligence adopted in 2019 by OECD (OECD, 2019).
- UN Commission report "Legal issues related to the digital economy – artificial intelligence" covered in the 2020 session in Vienna (UN Commission, 2020) and supplemented by "Legal issues related to the digital economy – proposal for legislative work on electronic transactions and the use of artificial intelligence and automation" in 2021 (UN Commission, 2021).
- Recommendation on the ethics of Artificial Intelligence adopted at the 41st session UNESCO General Conference in 2021 (UNESCO, 2021).
- World Telecommunication Development 2022 Conference focusing on progression of policies, strategies and guidelines for sufficient and prompt

implementation of the digital economy including the use of AI (ITU, 2022).

These documents are the guiding legal basis for countries in the field of development of legislation regulating the use of information technology and Artificial Intelligence specifically around the world supplemented by various organizations with different fields of expertise (Taran, 2023, 2). However, it is distinctly recognized that Artificial Intelligence regulation is complex and existing policies are not yet complete, requiring further investigation taking into consideration existing legislation while also considering current quickly changing market trends and risks to modernization (Hacker, 2020, 21).

2.7 New Approach: AI Use in State Budget Planning

In 2020 Fernandez-Cortez, Valle-Cruz and Gil-García questioned if AI can help to optimize the public budgeting process on the Mexican example. They proposed a methodology for the Mexican government taking into consideration human development index, GDP to assess financial development, the corruption rank to validate government condition, and the progression of the government debt. As a result, the suggested allocation of the public budget, produced by AI, presented increases to the financial plans for those areas that had less growth in recent years and budget decline for those that had greater growth. The outcome of the research can be considered logical considering Mexican country specifics, however it must be recognized that the result is not yet advanced enough and requires upgrading to be implemented.

Afterward, Valle-Cruz, Fernandez-Cortez and Gil-Garcia (2022) also studied the overall potential of Artificial Intelligence in government decision-making for resource allocation. Research results show that algorithms and AI techniques have proved potential to support institutions responsible for decision-making processes, especially in state budget planning, as well as complement or substitute other analytical techniques used so far. Authors highlight that key benefit of using AI to distribute resources is that it provides guidelines and allocation criteria to achieve multiple goals, bring both technical and political rationality to the budget process, enhance existing best practices and provide additional evidence to support them. Furthermore, research points out that these techniques help to discover innovative approaches and generate new ideas for government decisions, which is reachable through proposing different scenarios and models derived from AI simulations.

Grove and a peer group assessed the truthfulness of human and AI generated decisions, and the study established that on average machine generated forecasts are about 10% more accurate than human prognosis (Grove et al., 2000, 21).

Moreover, Marotta and Au (2021) studied AI opportunities and weaknesses in budgeting. They claim that financial planning executed by AI provides various ways of budgeting process improvements. Firstly, Marotta and Au (2021, 8) highlight that benchmarking exercises within the budgeting rounds can be supported by using text analytics techniques empowered by machine learning, like "Natural Language Processing" or "Text Mining". This AI capacity can help government institutions to convert text into relevant recaps summarizing the most important insights. Furthermore, AI analysis offers assistance in better distinguishing the desires and needs of country residents as a foundation for the decision making process. As a benefit of that, evidence collected from social media can be utilized in financial planning and support decisions that correspond to public expectations. Additionally, AI contributes to better data visualization, by highlighting behavioral trends and summing up social network patterns, that can be used to react timely, more efficiently and target main key objectives determined by algorithms. Marotta and Au (2021, 9) also claim that algorithms are good at identifying cause-and-effect relationships providing new common sense for measuring the financial results.

In 2003 three researchers explored the issues of financial planning components that remain with new tools implementation. However, these issues can be addressed with AI technology. Below is the summary table composed by the author based on previous chapters and study done by Neely, Bourne and Adams (2003, 23).

Table 1. *Budget issues (Neely et al, 2003) and their AI solutions.*

Budget component	**Brief problem description and AI solution**
Budget seasonality	Budgets are updated and reviewed seldom, normally once per year. With improved resource and time allocation enhanced with AI organizations can carry out planning tasks more regularly improving the quality of the outcome.
Budgeting price and time resources	Budgeting is expensive and time-consuming. AI provides better time management and cost optimization via process automation.
Budget assumptions	Budgets are usually based on guess-work. Assessing all the potential outcomes of different assumptions takes a lot of time and frequently remains unvalidated. AI can resolve it via the

	generation of an unlimited number of scenarios based on an extensive number of assumptions.
Budget focus	Budget is usually focused on cost reduction and allocation. AI can find solutions to consider multiple focus areas and increase value.
Budget compromise	Budgets often make stakeholders neglected. AI allows governments to take into account more opinions, demands and expectations of different stakeholders and make harmonized decisions avoiding discrimination.
Budget control	Budgets are controlled by the government which increases abuse of power risk. AI is an independent tool that ensures decisions are made in a democratic manner.
Budget changes	Forecasting is complex and bureaucratic. AI can speed up the process ensuring that changes are adopted more easily and quickly.

3. Case of Estonia

3.1 Overview of Estonian's State Budget Planning and AI

The Ministry of Finance (2024) states the main principle of the Estonian State Budget established in Fiscal Policy and approved by the ministry. Estonia State Budget principle is to establish an environment for continuous economic and employment rise that improves the well-being of the people and ensures long-lasting sustainability. Fiscal Policy and State Budget Act are the core documents for the State Budget Strategy that is being updated every spring by the Ministry of Finance and used to draft the state budget for the upcoming periods. The State Budget Strategy declares budget principles and government priorities for the next years, finance analysis and estimation of economic progression as well as other relevant material necessary for financial management. Every ministry and constitutional institutions carry out their own planning and budgeting activities. Going forward the Ministry of Finance gathers their budget requests and develops the state budget for the upcoming year, government strategy for the next four years and the stability forecast compliant with the Stability and Growth Pact. Additionally, in 2020 Estonia adopted Performance-Based Budgeting with intention to obtain more sufficient public functions with better quality of public services, government and staff costs optimization and flexible management minimizing bureaucracy. Performance-Based Budgeting (PBB) is result oriented approach when public sector organizations financing depends on the results organizations deliver (Robinson, Last, 2009, 2).

Estonia's national artificial intelligence strategy and Kratt highlight that AI is good for generation of recommendations, targeting and increasing the accuracy, optimisation, prioritization, prediction and forecasting. (Kratt, 2023) These capabilities exactly match with the nature of state budget planning, therefore studying AI usage in Estonian budgeting can be considered relevant and reasonable.

3.2 AI Awareness in Estonia

With the introduction of AI, Estonian governmental agencies started paying more attention to residents' digital literacy and overall AI awareness. The Ministry of Economic Affairs and Communications ordered a research about Estonian residents' awareness and attitude towards AI in 2023 (Kantar Emor, 2023). The goal of the study

was to comprehend the mindset of Estonian residents towards AI-driven solutions, what are people's AI expectations and concerns. Study results show that, according to people, AI has a wide potential in various fields that include medicine, public administration, document management, information retrieval, translation, reporting, customer service, traffic management, data analysis and urban planning. Estonians also believe that AI could increase efficiency and improve the quality of services in various areas and 40% of respondents support the inclusion of AI in the public sector services. More than 50% of the respondents think that AI should be utilized in tasks where human intervention is not always necessary. Nevertheless, 60% of the population feel that they do not have enough relevant knowledge about AI. Another research outcome covers attitude towards employment dynamics. According to study, 47% believe that AI can increase unemployment in Estonia, yet 64% support the idea that AI will increase human capabilities instead. Additionally, the study points out that 89% of Estonian residents believe that the government must be cautious when integrating AI in the public sector. The study is concluded with the set of recommendations for the Ministry of Economic Affairs and Communications. The main advice is to raise awareness by preparing a factual introduction of AI to the population, explaining its feasibility in everyday life and public services. Results also highlight the importance of paying special attention towards the most skeptical target groups like women with basic, secondary or vocational education, residents of Virumaa province and pensioners. Ultimately, Estonia has a good level of digital literacy, however the government is continuously working on its further improvements focusing on AI specifically, its rapid expansion and plans to implement it in the public sector processes.

3.3 National Legal Landscapes: AI Governance in Estonia

Estonia is recognizing the legal work of the organizations highlighted in the literature review, however, Estonia as many other countries, is additionally working on country specific AI studies focusing on legal regulation of new technologies in Estonia. For example Estonia was one of the first countries that developed a national Artificial Intelligence strategy (Kratt, 2023), started actively investigating Artificial Intelligence capabilities in e-governance and is continuously contributing to international AI knowledge.

Legal association created by the State Chancellery and the Ministry of Economic Affairs and Communications validated the image of general AI law in Estonia, and highlighted key regulation factors to consider (Kerikmäe, Pärn-Lee, 2020, 564), below is the list of principles from the report summarized with paraphrasing by author:

- AI technology requires official definition on a governmental level.
- AI has different judgment from civil and criminal law perception.
- AI has a different outlook and anticipation of involved partners that might be not aligned with the government view and legal basics.
- Legal representatives need better technological understanding from an intellectual and also practical angle, meanwhile, IT professionals require understanding about how the regulatory framework can assist modernization and what legal obstacles can appear. Summing up, legal experts call for better alignment between IT and legal point of view.
- AI, similarly to other technologies, can easily cross social borders and cause many problems associated with this, like blurred borders between civilian and military societies or role of Estonian private and the public sector.

Initially the goal of the work was to create a draft version of AI regulation law in Estonia. However, after studying Estonian legislation, speaking to stakeholders from both private and public sector, taking part in various meetings and workshops, the group of Estonian legal experts determined that fundamental changes in legislation and separate law focusing on AI use only are not currently rational or needed (Kerikmäe, Pärn-Lee, 2020, 564). Authors highlight that the Estonian legal association's conclusion was that AI will remain a human centric tool for performing tasks and demands requested by people, thus the subject of AI legal regulation will remain individuals themselves and regulatory changes are necessary only in the form of additions and clarifications to the already existing law. They compared AI to animal regulation. From the legal perspective animals are treated as something more than just things or inanimate objects, however, they do not have legal personality and their owner or representative is responsible for their actions.

Furthermore, as mentioned already, one of the most important AI related documents in Estonia is the official national strategy firstly developed in 2018 for the years 2019-2021 and supplemented in 2021 with the strategy for 2022-2024 (Kratt, 2023).

Key regulatory takeaways and required legal activities from Estonian National AI strategy 2022-2023 summarized with paraphrasing by author:

- Estonia aims to progress the draft Act altering the Administrative Procedure Act to set up common principles for automatic administrative acts, proposing supplementary formal requirements to make the processing of individual data in authoritative strategies more transparent.

- The importance of Estonian partnership with EU in the negotiation of the AI regulation establishing balanced rules on Artificial Intelligence Act, taking into account Estonia's views, supporting AI implementation across the EU including Estonia and avoiding over regulation.
- Estonia recognizes the importance of cooperation in the development of civil responsibility practices for the AI and EU digital era, including collaboration in structuring future EU legislation maximizing benefits for Estonia.
- Estonian goal is to contribute to the Convention on Artificial Intelligence of the Council of Europe promoting benefits for Estonia.
- Estonia aims to contribute to AI policy development in both EU and internationally, maximizing Estonian interests and guaranteeing compliance of AI capabilities with the human centered digital state standards and the concept of reliable AI.
- Estonian centric regulatory activities have been switched towards finding solutions to country specific problems that need and can be regulated outside of EU action, taking EU regulation decisions as a basis.

At the end of 2023 Estonian Minister of Foreign Affairs of Estonia Margus Tsahkna announced that Estonia aims to invest 20 million euros in development of AI solutions for public sector e-governance (Karhu, 2023). The goal of the investment is to cultivate sustainable Artificial Intelligence solutions and advance further development of the new tools driven by public institutions. This decision is aligned with the Estonian National AI strategy. In addition to that, Estonia does not stop there and continues to work on AI strategy for the upcoming 2024-2026 years and service improvements (Karhu, 2023).

To summarize the above, it is important to highlight that Estonia's strategy in the context of legislative regulation of AI is primarily based on the EU actions. Estonia actively participated in the creation of an EU Act, as well as many other official legal workings directly covering the regulatory issues of Artificial Intelligence across EU members. Estonia's approach is to ensure that the EU proposal takes into account Estonia's views to the maximum extent possible, afterwards the government aims to start improving country specific AI issues and making additions to the internal legislation of the country. It is also important to mention that according to Oxford Insights (2023) Estonia ranks 17 out of 193 studied countries in the government AI readiness index, USA being the leader of the research. It is worth mentioning that Estonia has a leading position across Baltic countries where Latvia ranks 48 and Lithuania 35. Based on this, it can be claimed that the Estonian government has taken and continues to take all the necessary steps for the successful implementation of AI at the governmental level from the legal perspective.

4. Research Results

This chapter outlines the evidence of empirical data collected through multiple interviews conducted by the author with Estonian government officials and experts working on public sector services improvements, AI regulation, AI implementation, training and research projects within EU and Estonia. It also covers the results of a survey conducted among Estonian residents about their attitude towards AI expansion in the public sector and state budget planning specifically. Different outlooks were considered to get a deeper understanding of AI implementation potential in state budget planning as all of the experts are related to AI projects at different levels.

4.1 AI's Breakthrough in Public Administration

Artificial Intelligence phenomenon compels public organizations to face plenty of advantages alongside significant challenges, causing the need for finding the balance between AI utilization benefits and addressing emerging risks. Kristiina Tuisk, ex Adviser for the State Budget Department in the Ministry of Finance and current AI Trainer, indicated the high potential of AI technologies saying that "*AI is a technology invented with the good purposes that of course has a dark side as well, but it depends on who and how utilizes it*". She brought an example of ChatGPT saying that "*You can use it for preparing different kinds of texts, emails etc, but it can be used for phishing as well. So we definitely need to raise awareness about these things*". Yet, she summarizes AI potential saying "*we can benefit a lot from this*". Kristel Kriisa, AI Project Manager from Estonian Information System Authority, also says that "*now everyone has to think about their problems, what kind of data they have and whether this data could be used to solve the problems more efficiently and with rapid AI expansion today is the perfect moment for that*". Henrik Trasberg, New Technologies Legal Advisor in the Ministry of Justice, also claims that "*We are clearly seeing that it's going to have a very large impact across all different domains. Thus in Estonian strategies it is clearly marked and visible that we need to understand how to get the value out of this development*". Estonia is known for its technological success and according to interviewed experts our government institutions are enthusiastic about AI-driven solutions, not forgetting the need to find the ways to address the new challenges.

Artificial Intelligence represents a significant change in technological progress, raising the question of its integration in the current public service procedures. Proactively learning and optimizing its potential value is worth attention. In order to benefit from AI

implementation it is important to acknowledge current problems and process imperfections, determining required features for their solutions together with validating potential risks. This will help to outline what are the new tool's technical requirements in practice and what potential negative consequences should be taken into account. If the expected net benefit outweighs the foreseeable challenges, the adoption of new technology is worth consideration and that is what is currently being done in Estonia.

4.2 AI for State Budget Planning: Opportunities and Challenges

In order to maximize AI efficiency in state budget planning it is important to accurately map new technology positive and negative features. One of the key advantages of AI published in academic discourse is its capacity to upgrade the decision-making process. Kristiina Tuisk from the Ministry of Finance agrees with the AI feasibility to generate various scenarios, thus helping the government institution responsible for the decision making process to choose which plan is better for the country, adding "*I've done it myself when I was working for the Ministry of Economic Affairs. Generative AI tools are very fast in mapping different processes, like proposing project time frames and helping to generate different ideas or first steps, that you can analyze further and make a decision*". Additionally, she called attention to the AI data visualization feature saying "*there are tools that help you to visualize the process together with offering the course of action*", also mentioning that AI can generate the outcome with and without beforehand provided details adding that "*these are very precise and helpful, especially when you're just starting somewhere*". She summarized it saying "*AI is a very good decision making partner which also helps you to argue and coming back to state budget planning, these tools can help there as well*". Considering that, the public sector including state budget planning can potentially benefit from introducing AI in the existing approaches by taking into account a wider range of scenarios and present results in a more user-friendly manner.

However, Kristiina Tuisk also highlights that "*We always need to double check AI decisions, analyze the strengths and weaknesses of AI proposed solutions ourselves as well, since we are in charge of our decisions and AI doesn't take this responsibility*". Kristel Kriisa from Estonian Information System Authority also finds it important to treat AI as a decision making partner only explaining that "*We cannot let algorithms decide. They can assist us, but they are not making decisions for us*". One of the main reasons why AI has to be controlled, audited and used very carefully, claimed by Kristiina Tuisk, is that "*AI models are biased and can hallucinate*". Nevertheless, Kristel Kriisa admits that AI tools are still worth consideration and testing in governmental institutions, saying "*We've had more than 130 different projects in the*

public sector, many of them are pilot projects, so you always need to try and see if it works. Experimenting is good because then you actually get practical knowledge about things".

Additionally, Kristel Kriisa, from Estonian Information System Authority, brought an example of AI efficiency in financial data analytics saying "*Estonian Tax Office, for example, already uses AI to find possible tax fraud cases*". Kristiina Tuisk also agrees that "*if there's good data, AI allows you to look back into historical evidence and analyze large amounts of information that is quite impossible to process for human beings and sometimes even Excel*". Furthermore, she also noted that AI technologies have adaptability features to meet the specific needs of individual users saying "*these tools make it easier to analyze results for both professionals and regular people as well*". Henrik Trasber also agrees with AI analytic capability saying "*I think it's quite evident that AI has potential in state budget planning since it has pretty good analytical capabilities and these seem to be quite easily extended to narrow specific tasks particularly*". Eneken Lipp from the Ministry of Finance confirms that "*Our main challenge currently is data quality and lack of data-analysis capability in the agencies*". Mapping AI capability to analyze and manage the data with current data analytics challenges in the Ministry of Finance, it can be argued that AI can significantly improve the current practices. Considering that state budget planning involves sharing various analyses with diverse stakeholders, it's essential to guarantee that the outcomes are both accurate and easily understandable for all parties affected. Utilizing AI's adaptability and analytical skills can greatly improve the efficiency of the budgeting season.

Kristiina Tuisk also emphasized AI capability to speed up project delivery saying "*When you have two months for one project, but you actually need six, with AI you can skip some of the steps executing them using AI solutions*". Sofia Paes from the Ministry of Economic Affairs and Communications also highlighted machine learning capability to improve project efficiency with AI automation saying "*We don't have enough human resources and have a lot of tasks, with AI things can be automated to let public sector servants allocate their time efficiently and focus on more complicated tasks*". She also added that "*AI offers us more convenient ways of execution together with getting services or projects ready as quickly as possible*". Eneken Lipp confirms that the Ministry of Finance has been already working on finding solutions and prioritizing the automation saying "*Our accounting, cost-accounting and budgeting data is integrated and there is quite a bit of automatization used in the processes*". Automation and efficient project delivery features are of particular significance within the state budget planning, considering that service delivery delays may lead to harmful consequences for the relations and trust between the government and society, as well as financial stability

of the state.

As mentioned earlier, one of the main AI advantages is considered to be its expanded availability of services. According to Kristel Kriisa assertion "*AI tools in many cases can be more reliable and trustworthy than humans, as machines unlike people do not get tired, sleepy or have bad days*". However, she admits that "*AI tools can argue, make everything faster and easier but it's not gonna replace us*". Sofia Paes from the Ministry of Economic Affairs and Communications also agrees that there is a common opinion that AI will cause unemployment to increase saying "*People are skeptical due to the risks related to the list of jobs*". Yet, she disputes this statement by saying "I*t's important to understand that implementation of AI solutions will also create new workplaces. We will lose somewhere, but we will get more workplaces in other fields at the same time, so it will be somehow balanced*". This again confirms that AI tools can be a helpful support function or partner in the process of state budget preparation, justification and approval without threatening to steal people's jobs.

In addition to AI-powered opportunities, there are significant challenges associated with AI. Kristel Kriisa from Estonian Information System Authority claims "*There might be conflict of interests when it comes to data and people's privacy*". Her main concern about AI usage is related to people's motivation to share knowledge or data with AI tools saying "*If you want to become a musician, you learn how to play an instrument, how to sing, how to write songs, how to produce and record them, but then you see that machines can do it in seconds, which is shocking. But I think it's gonna happen anyway and we should think about the rights of people and their data*". With rapid technology expansion we, as a society, may undergo significant changes in the importance and relevance of habitual behavior. Kristel's example explains the importance of accurate data protection, AI regulation and cybersecurity questions Estonia can potentially face with AI integration in state budget planning. The primary concern is whether data owners are comfortable with authorizing Artificial Intelligence to process their data.

Furthermore, Sofia Paes indicated the importance of taking into account AI implementation complexity saying "*if an organization is planning to implement AI solution it is important to have the necessary amount of data, experts who can come up with such solution and set up the initial stages, end goal has to be clearly formulated, required funding must be accurately calculated, additionally all such projects take time, so you need to take into consideration that it won't happen next day*". Kristel Kriisa also highlights the complexity of AI implementation in state budget planning saying "*For this case you will need lawyers, data experts, business people, developers and so on, it's really complex. Additionally, it's slightly harder to strategically lead this type of change*

because you would basically need all the ministers and many other parties involved. However, most of the ministries are already there thinking about their strategies and what is the best way to make use of it, but some other ministries are not there yet. I guess it's gonna take some time, small steps and one day it's going to be here anyway". Kristiina Tuisk also emphasized complexity of AI integration in state budget planning highlighting the key implementation factor being usage readiness or project background work saying "*public sector needs to come up with the guidelines in every level, map what kind of documents AI can work with, identify main bottlenecks that can be solved with AI capabilities, structure everything and evaluate first*". For the practical AI utilization aspect of the project she added that "*I don't recommend training your own model to plan the state budget. It's too expensive and complicated. I think that we can benefit more from just using existing AI tools at least now*". This again confirms the feasibility of AI in state budget planning, although requiring a lot of effort upfront from government departments, policy makers and managers to ensure technology efficient usage and acceptance among employees also described in UTAUT theory. In particular, this evidence ratifies the significance of accurate project management, role of leadership and the importance of expectancies when implementing AI in state budget planning which is also identified as core criterias for accepting the change in UTAUT. While Estonia currently does not yet have the full infrastructure for the AI project, experts note that the government representatives are promptly developing guidelines and strategies, as well as assessing possible approaches. Even though immediate integration is not realistic, there is no doubt that AI will play a significant role in improving the budget planning process in the near future.

4.3 Resident Perceptions of AI: Readiness and Attitude Insights

Implementing new solutions to the public sector it is critical to assess the potential social reaction to approach change, overall technology public awareness and end user acceptance. State budget planning consists of financial allocation of different state resources including taxpayers capital allocation. Although civil society are not involved in state budget decisions, they are direct public service users, thus can be considered as principal members whose perspective should be included in evaluation according to UTAUT. Hence, it is important to consider public attitudes towards new approaches in managing their monetary contributions. In order to take into account and assess different opinions and level of AI awareness, the author conducted a survey among Estonian residents from different industries, levels of education, working for both private and public sector. The survey results are presented in this chapter.

Firstly, residents were asked to rate their AI concept awareness from 1 to 10, 1 being the

lowest and 10 the highlest. Survey results show that 46% of respondents rated their level of awareness at 7-8 and 14% of questionnaires indicated 9-10. Ultimately, 60% of respondents have sufficient knowledge about AI according to their personal opinion. Furthermore, 10% of respondents rated their AI knowledge at level 1-3 and 30% at 4-6. This highlights the risk of skepticism to accept AI integration in state budget planning driven by approximately 40% of Estonian residents having a lack of AI concept understanding that should be addressed by the government in advance. Henrik Trasberg from the Ministry of Justice mentioned this problem among both ordinary people and those who will utilize AI in the public sector saying "*Level of knowledge is insufficient. Clearly in comparison to many other countries our digital literacy is quite okay, but what is happening with the transformation is super fast and the society is not ready for that. Learning curve has to be very fast, social readiness was one of the first intervention points when we tried to develop our AI policies"*.

Secondly, respondents were asked to express their opinion about particular AI advantages and challenges highlighted in the theoretical background of study. According to survey results most people agree that AI can reduce risk of human error, improve budgeting cycle time management, enhance efficiency in resource allocation and improve identification of cost-savings opportunities and revenue projections. Above mentioned AI advantages were also highlighted by interviewed experts, thus it can be claimed that public and expert opinion do not contradict each other. However, respondents are ambivalent about AI capability to provide greater transparency in financial decision-making. This can be explained by common public preference to receive important answers not from artificial, but real people. Kristiina Tuisk also confirmed that "*When it comes to getting some kind of answers, like chatbots, especially outside working hours people are more than fine with AI solutions, yet when making decisions and especially about people themselves, then the readiness is quite low and many people still need a human being*". Kristel Kriisa also expressed similar concern saying "*when it comes to very basic situations where you just need to make things faster people think that it's a good idea, but when you actually start making decisions people don't want that, I guess it's gonna take time*".

Table 2. AI Advantages for State Budget Planning.
Source: Author

AI Advantages	**Survey Result:**	**% value**
Greater transparency in financial decision-making.	Agree - 44 Not Sure - 35	42% 34%

	Disagree - 25	24%
Human error risk reduction.	Agree - 79 Not Sure - 11 Disagree - 14	76% 11% 13%
Improved budgeting cycle time management via AI permanent availability.	Agree - 68 Not Sure - 29 Disagree - 7	65% 28% 7%
Enhanced efficiency in resource allocation due to processes automation.	Agree - 88 Not Sure - 9 Disagree - 7	85% 9% 7%
Better identification of cost-savings opportunities and revenue projections via improved data governance.	Agree - 81 Not Sure - 15 Disagree - 8	78% 14% 8%

Furthermore, survey results show that Estonian residents agree that AI solutions lack outside of box thinking and the AI regulatory framework is in its infant phase. Additionally, residents are cautious about an increase in unemployment level. Unemployment concerns identified in the survey results were also mentioned as common delusion by interviewed experts. Kristiina Tuisk mentioned "*People are concerned, since it's a new problem for them, since there are some jobs where AI has already proven to be capable of replacing people. Thus I think that is why we need to teach people and make more AI training sessions available to reduce ignorance*". Moreover, respondents do not believe that AI-based tools maintenance costs are high, AI solutions lack ethics, and AI can never guarantee to hit the most optimal solution. Public and experts' opinions do not exactly correlate here. Ethical concern is one of the AI risks mentioned by experts, but not identified by Estonian residents. Kristiina Tuisk said "*there are a lot of questions around AI, ethical questions is certainly one of them*". This again confirms the importance of raising awareness and ensuring people know more and feel safe with AI implementation leading to technology acceptance.

Table 3. Risk associated with AI in State Budget Planning. Source: Author

AI Risks and Challenges	**Survey Result:**	**% value**
AI solutions lack outside of box thinking.	Agree - 62 Not Sure - 21 Disagree - 21	60% 20% 20%
	Agree - 30	29%

AI-based tools maintenance costs are high.	Not Sure - 48 Disagree - 26	46% 25%
AI solutions lack ethics.	Agree - 45 Not Sure - 30 Disagree - 28	43% 29% 27%
AI can never guarantee to hit the most optimal solution.	Agree - 41 Not Sure - 30 Disagree - 33	39% 29% 32%
AI can provoke an increase in unemployment level.	Agree - 65 Not Sure - 20 Disagree - 19	63% 19% 18%
The AI regulatory framework is in its infant phase.	Agree - 77 Not Sure - 19 Disagree - 8	74% 18% 8%

Moreover, respondents were asked to assess the AI feasibility to improve specific budgeting tasks. Survey results highlight that Estonian residents agree that AI can potentially support the budget planning process with financial analysis, trend and pattern recognition, proposing different scenarios, providing regular updates and reviews, data collection, representation and reporting. This result corresponds to the expert opinion of the interviewed people from governmental institutions dealing with AI integration in the public sector. Henrik Trasberg for example said "*I see quite a bit of potential to use AI as an analytical tool in the budgeting process*". However, Estonian residents are slightly skeptical about AI capability to harmonize the budget process by considering more opinions, demands and expectations of different stakeholders. This result can be again explained by incomplete understanding of AI technical capabilities.

Table 4. Budget Components to be Improved with AI.
Source: Author

Budget Components	**Survey Result:**	**% value**
Data collection.	Agree - 86 Not Sure - 13 Disagree - 5	83% 13% 5%
Data representation and reporting.	Agree - 86 Not Sure - 12 Disagree - 6	83% 12% 6%
	Agree - 73	70%

Financial analysis.	Not Sure - 24 Disagree - 7	23% 7%
Trend and pattern recognition.	Agree - 86 Not Sure - 14 Disagree - 4	83% 13% 4%
Proposing different scenarios.	Agree - 72 Not Sure - 21 Disagree - 11	69% 20% 11%
Regular updates and reviews.	Agree - 71 Not Sure - 20 Disagree - 13	68% 19% 13%
Budget harmonization (consider more opinions, demands and expectations of different stakeholders).	Agree - 53 Not Sure - 32 Disagree - 19	51% 31% 18%

Further residents were asked to evaluate the importance for government agencies to invest in AI technologies for improving budget planning processes. Results show that 81% find it important and only 19% disagree with the statement. Research showed that the more people know about AI, the more they think the government should invest in AI for state budget planning. Thus, Pearson Correlation is positive. This again confirms that Estonian residents are receptive to the government's intention to find new solutions for process improvements and believe in AI potential for this specific case. However, only 24% of respondents think that the public and policymakers are receptive to the use of AI in state budget planning, 20% were neutral and 56% think that policymakers will be resistant to AI implementation, although experts' views contradict the survey results. Additionally, 78% expressed their support towards pilot programs to be shared with the public to test the effectiveness of AI in state budget planning before full-scale implementation, 16% were not sure and only 6% do not think it is required. This determines the social interest towards gaining better understanding of AI technologies before integrating them in such important decisions like allocation taxpayers funds. Furthermore, residents were asked to identify what AI disclosure and educational procedures they prefer to receive before and during the implementation. Below is the list of most common and relevant suggestions summarized by author from the survey results:

- Material on how AI supports human rights, what are potential ethics risks and how are they going to be mitigated.
- Material on how AI will be integrated in decision making and to what extent.

- Transparent project delivery (keep people informed of how exactly AI will be implemented).
- Free of charge AI introduction courses and training (explain AI advantages, success stories and potential risks).
- More information shared via media (TV, press, social media etc).

Additionally, respondents were asked to provide their thoughts on what outcome they would expect from AI integration in state budget planning. Below is the list of most common and relevant highlighted ideas summarized by author from the survey results:

- Elimination of corruption and fair decisions.
    - *Prioritizing areas that are most in need.*
    - *Factual transparency in numbers.*
- More focus on consequences of actions or plan B.
- Real time budget updates available on the official government website 24/7.
    - *AI created graphs and charts with highest and lowest percentages of budgets in each state sector.*
    - *Real time evaluation and modeling of different scenarios including probability estimates.*
- Improved reporting.
    - *Cost-benefit analysis of different actions in numbers.*
    - *Patterns analysis and improved data overview.*
- Human error risk elimination.
    - *Come up with no emotion solutions that humans cannot perform.*

According to survey results, people primarily expect AI to improve government to people communication by clearly disclosing the budget calculation process rather than merely providing amounts, representing the current budget dynamics in a user-friendly manner constantly available for people, improving decision making process and analytics. These elements are of particular importance considering that in 2024 Estonia increased VAT from 20% to 22%, hence it is critical for the government to justify the decision, which can be potentially done by meeting resident's expectations described above with the AI implementation.

Overall, 60% of respondents believe that implementing AI in state budget planning could lead to more accurate financial forecasts and 40% are not sure either disagree with the statement. Research shows that those who are more familiar with AI capabilities have a more positive attitude towards AI potential in state budget planning process improvements and those who lack knowledge are more skeptical about it. Thus, Pearson

Correlation is positive. According to UTAUT social persuasion is one of the core factors impacting user readiness to accept new technologies. This evidence again underscores the importance of public education in the field of emerging AI technologies.

4.4 AI Governance: Regulatory Dynamics and Challenges

Current Estonian regulatory framework governs the utilization of technology within both the private and public sector, covering core principles like GDPR, cyber security, human rights and many others. However, AI is significantly different from technologies used so far, due to its extraordinary capabilities. As a result of that policymakers and lawyers across the globe immediately raised the importance of additional regulations to be introduced with rapid AI expansion. Therefore, it is critical to take into account AI regulatory framework when implementing machine learning in Estonian state budget planning. This chapter focuses on current AI regulations that can potentially limit or support its utilization in Estonia.

Henrik Trasberg is new technologies legal advisor to the Minister of Justice who has contributed to the EU AI Act negotiations ensuring Estonian interests are included there. He claimed that the main current legislation shortcoming is the absence of a framework to prevent the harm, saying "*Our current legal system is able to tackle the consequences, once the harm has been done, but we don't really have a legal framework for preventing it*". Yet he mentioned that "*key change for that is going to be the EU AI Act which is going to create the harmonized rules for All European countries. AI Act is ready and will be approved very soon*". He highlighted the approach to address the existing problem with emerging AI technologies saying "*AI Act is very concrete in making sure that in the process of developing the AI systems and in operating the systems there is constant risk assessment, risk mitigation and transparency in human supervision*". Indeed, experts expect an AI Act to change the current AI environment within the EU, ensuring clarity by establishing approved practices, transparency, and guidelines for utilizing new technology in different spheres, including state budget planning.

One of the legal challenges mentioned by Henrik Trasberg is the ability to adapt to change saying "*AI Act will only come into force gradually over the course of next two to three years, so it will take time for the legal system to catch up*". However he claimed that this is not going to be so difficult for Estonia and the EU saying "*EU is doing it quite fast, I think that there are many other regions, particularly USA, that are going to struggle more*". Kristel Kriisa also mentioned that "*it's not as tricky in Estonia compared to Germany or France, because we have less bureaucracy involved*". Ability

to adapt and accept new technology is often complicated and AI is not an exception. According to UTAUT, a supportive environment is one of the core factors impacting users to accept new technology. Nevertheless, Estonia is one of the leading e-governance countries with sufficient experience in integrating new solutions into existing approaches, thus as mentioned by experts Estonia can be considered deemed conducive for AI integration in state budget planning.

Additionally, Kristiina Tuisk mentioned that the origin of AI might be the challenge saying "*EU is regulating something that is owned and developed by others and this is problematic*". Henrik Trasberg does not entirely agree with that statement saying "*even if models are trained outside but the moment of service being provided is in the EU, they have to comply with EU rules, so it isn't that big of a problem*". But he also added that it might be problematic with some specific markets saying "*But if those systems are developed somewhere in China or Russia or somewhere else with no reliable source market, that it's gonna be a problem*". This highlights the importance of choosing trustworthy service providers who adhere to EU regulations ensuring security and efficiency of AI-driven solutions in state budget planning.

Another legal issue raised by Kristiina Tuisk is the rapid development of AI saying "*We are regulating something that is developing very fast, faster than you can regulate*". Kristel Kriisa also said "*I think regulations will never be up to date, since the situation is changing so rapidly and the whole field is changing so quickly that once you get the right regulation ready, it's already outdated again*". Henrik Trasberg confirms that this problem is real saying "*It's always very difficult to remain relevant throughout the years as the technology changes"*. He then explained how this risk is addressed in the AI Act saying *"Lawmakers tried to make the laws a bit more abstract and try to have this kind of future-proofing mechanisms in there. For example, if you look at AI Act General Obligations they're actually very general. There are mechanisms built into the Act to assist with this issue*". This underscores the importance of considering consequences of AI rapid development when implementing these tools in state budget planning. However, as mentioned by legal expert EU AI are designed in a pliable manner to remain applicable to future changes, guaranteeing that tools are compliant even after the change.

Henrik Trasberg highlighted one of the major AI Act strengths saying "*I think the good thing is that it has a pretty nice flexibility"*. Additionally, he paid attention to sandbox obligation for the public sector saying "*There will be a lot of helping assisting mechanisms, meaning that countries are going to have sandboxes essentially in public service. This will allow public sector agencies to assess and test whether AI tools*

actually help to mitigate risk and are compliant". AI Act weakness mentioned by Henrik Trasberg is approach complexity. He said that "*It is very hard to predict how well it's gonna function because it is quite a complex approach, sometimes not measurable*". Furthermore, he identified another AI Act potential weakness saying "*There is the question of responsibility of who should be actually reliable if the consumer gets bad input from the system. This issue wasn't sufficiently analyzed and we hope it will work the way we want, but I think that it could have been more mature*". This confirms that the AI Act is addressing the main risks for the governmental organizations aiming to integrate AI in the budget planning, but further investigation and verification is needed to potentially enhance it in the future to fulfill additional requirements.

Furthermore, experts were asked if Estonia needs additional AI regulations on a national level. Henrik Trasberg said that "*AI Act is fully harmonizing in a sense that other EU countries cannot have AI specific regulations anymore*". Kristiina Tuisk also expressed the same opinion saying "*No, because Estonia is too small and we don't have our own technologies*". This confirms that Estonia does not need to regulate AI on a national level and should follow the general EU AI Act to efficiently implement AI in the state budget planning process.

Summing up, significant progress has been made by legal experts in developing the official EU AI Act, which will soon be implemented to tackle the primary risks associated with potential AI use in state budget planning across the EU zone including Estonia. However, government organizations responsible for state budget planning must remain vigilant about potential risks and exercise caution when deploying AI technologies.

4.5 Discussion

Assessing the results of the research has generated the following understanding, which provides an overview of the AI implementation in Estonian state budget planning. Both interviews with experts and a survey among residents were essential for elaborating findings to the defined research questions. This subchapter covers how the qualitative data depicted in the previous sections contributed to answering the research questions.

Interviewed experts determined the most impactful AI advantages driving machine learning implementation in the state budget planning process also supported by survey results conducted among Estonian residents. These are machine learning ability to accelerate and improve the process with technology high availability, adaptability and

automation features; efficiency in accurately visualize the data meeting the requirements of various stakeholders ensuring user-friendly experience; strong financial analytic capacity; competence in performing the role of decision-making partner supporting generation of different ideas or scenarios, mapping the processes and providing meaningful argumentation. Secondary data analysis also determined the same AI advantages driving the initiative execution and justification. Research findings identified the most impactful AI risks that could potentially act as barriers for the project. These are ethical and data concerns of AI-solutions; lack of accountability due to hallucination risks leading to the need of systematic technology controls; insufficient AI awareness among potential technology users and ordinary people leading to low trust and fear of unemployment. Moreover, one of the most significant challenges identified in the research is project complexity expressed in requiring efficient management, leadership proficiency, a lot of background work and experts involved, thus no short term initiative execution. Similar aspects are particularly captured in UTAUT.

Research findings identified the importance of raising AI awareness on a national level. This was determined in the interviews and survey results. Experts recognized the insufficient public knowledge about AI-driven solutions, hence leading to difficulties in justification of implementation and user technology acceptance. However, survey results show that Estonian residents are interested in AI education. According to survey results residents prefer such education channels as social media, TV, group AI training and seminars. The core aspects the public is concerned about and what should be particularly covered in AI education are AI advantages, success stories, potential risks, as well as how AI solutions ensure human rights are protected. Estonian residents also accentuated the importance of project transparency when implementing AI in state budget planning. The result can be considered accurate since it corresponds to UTAUT.

Furthermore, research findings covered potential AI implementation legal limitations as well as how regulatory framework ensures successful machine learning integration in Estonian state budget planning. Research results show that the most impactful shortcoming of the AI Act is its relevance considering that it is hard to predict the future AI technology change. Additionally, experts highlighted the potential legal limitation with choosing a service provider, since not all AI-driven solutions are compliant with EU regulations. Moreover, research results identified that it might be challenging and time consuming for the government to adapt the AI Act. The research results show that the EU AI regulatory framework is in general very favorable and there are many aspects supporting AI integration in state budget planning. These are legally guaranteed transparency, harmonization, future-proofing mechanisms supporting law flexibility as well as obligatory to continuously mitigate and assess the risks. These legal factors

strongly support AI implementation in the Estonian state budget planning process.

Research findings indicate that AI has a lot of potential to improve the current process of state budget planning offering explicit examples of its utilization. These are generating an increased number of scenarios together with their financial analysis; argumentation and visualization support; improving communication with the residents by providing real time budget updates, more transparency in government decisions and current financial conditions of the country; assistance in decision-making by considering more aspects involved and particularly meeting public expectations, hence strengthening the relations with the country residents. Furthermore, research results present the set of recommendations for the governmental institutions aiming to implement AI in state budget planning. Results show that when integrating machine learning it is important to involve enough experts from different fields, ensure efficient project management and competent leadership who will drive the change. It is also critical to identify main bottlenecks of the current process and map them with AI features capable of improving them, prepare and accurately formulate guidelines on every level about AI utilization in specific tasks or actions. Furthermore, it is important to stay compliant, hence choose the trustworthy AI tools and carry out regular sandbox testing, risk assessments and mitigation as well as develop the mechanisms to prevent them. Study results also show that initiative to implement AI in state budget planning must also cover public centric focus by raising AI awareness among Estonian residents.

4.6 Limitations of Interviews and Questionnaire

This research was carried out using case study methodology following the core research principles described by Yin (1984). The author calls attention to validity and reliability. Yin claims that both internal and external validity play a role in research results, ensuring the cause-and-effect relationship of various factors is established and study is not generalized. In order to fulfill these requirements the author involved multiple sources of data to collect the evidence. Nevertheless, there remains a possibility for bias in generalizing the findings of this study due to the limited number of sources used for analysis, drawing results and conclusions. Reliability is expressed in the same study results if another investigator follows the same process in the future. Yin (1984) claims that it is feasible to apply the equal approach for other cases, but anticipating identical results is unrealistic. Additionally, in the initial stages the author planned to conduct more interviews, however not all experts agreed to contribute and some of them were able to provide their feedback only via email. As a result, the author gathered evidence from fewer experts than initially expected.

4.7 Prospects of the Future Work

This study looks at AI potential to improve the state budget planning process in Estonia. However, not only AI capabilities and challenges are the factors impacting the potential integration. In subsequent research there is a need to take a deep look at how exactly the process of state budget planning is organized, structured and managed particularly in Estonia. For future work it is necessary to identify existing IT-solutions utilized in the process as well as their major shortcomings, organizational capacity to execute the change in the current circumstances and common challenges government officials are currently facing when preparing the budgets. The outcome of additional evaluations will demonstrate the AI potential and rationale from different country-specific perspectives.

5. Conclusion

This paper, "Feasibility of Artificial Intelligence Technologies in Estonian's State Budget Planning" revealed that AI-driven solutions are feasible to improve the state budget planning process in Estonia.

In order to answer the first research question, the main AI advantages and disadvantages were analyzed. Before focusing on the country-specific example, an overview of the AI phenomenon, features and public service integration examples, were disclosed. Further, AI potential in the Estonian public sector particularly was examined. For the case study research, Estonian government officials and AI professionals were interviewed to gather insights about public sector AI implementation drivers and barriers identified from their e-governance experience. Based on that, the main recognized AI advantages for state budget planning were availability, adaptability, capability to visualize data, accelerate and improve the process, support financial analysis and perform as a decision making partner. Additionally, the main recognized AI challenges were low AI awareness, level of accountability, hallucination risk, data and ethical concerns as well as project complexity.

After highlighting the most significant AI advantages and risks, the study focus was altered towards the second research question. The goal of the second research question was to investigate the need and importance of raising AI awareness in Estonia affecting the new technology acceptance. The research results determined that the role of AI awareness is significant and Estonian residents require more education. Those who know more about AI have a positive attitude towards its potential implementation in state budget planning and those who are less educated are skeptical. Interviews with experts also highlighted the existing education gap and importance of raising AI awareness. Research findings identified the main public concerns associated with AI.

In order to answer the third research question, the author collected insights about the AI regulatory framework declaring the main legislative strengths and limitations impacting the AI implementation in Estonian state budget planning. The observation identified that captured strengths include improved transparency, ensured harmonized approach, obligation for regular risk assessment and mitigation, as well as future-proofing mechanisms included in the AI Act. The examination recognized such AI legal challenges as choosing compliant service providers, law relevance and time to adapt to AI Act for public sector agencies.

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Appendix 2 - Interview Results

Interview Questions

1. What is your attitude towards the growth of AI across the industries and public sector specifically?
2. What potential advantages of AI usage in the public sector can you highlight?
3. How can the government benefit from implementing AI?
4. What challenges might the public sector face with the implementation of AI?
5. How can the risk of AI integration in the public sector be eliminated?
6. To what extent is society ready for the use of AI at the governmental level?
7. Do you think that country residents know enough about AI capabilities?
8. Is there enough education materials available for ordinary people about AI?
9. What disclosing and educating procedures must be carried out among Estonian residents before implementing AI in state budget planning if necessary?
10. How would you rate the maturity level of the current AI regulatory framework?
11. What legal obstacles can limit AI use in state budget planning?
12. Do you personally see AI potential in state budget planning?
13. Which budget components are likely to be improved by AI?
14. How should the process of implementation be organized and managed?
15. What would be your recommendations for AI implementation in budget planning?

Interview Mindmap

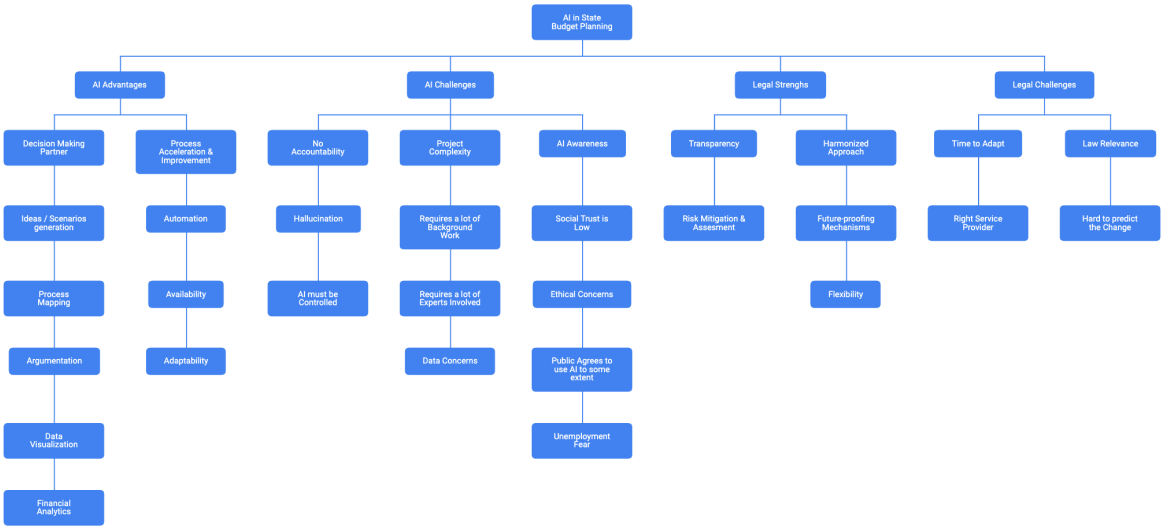

Figure 1. Key Concepts from the interviews

Appendix 3 – Survey Results

Survey Questions

1. How old are you?
2. What is your sex?
    a. *Male*
    b. *Female*
    c. *Non-binary*
    d. *Prefer not to answer*
3. What is the highest degree or school level you have completed?
    a. *Less than a High School diploma*
    b. *High School graduate or equivalent*
    c. *Bachelor's degree*
    d. *Master's degree*
    e. *PhD or higher*
    f. *Trade/Technical/Vocational school*
    g. *Prefer not to say*
4. In which department or sphere of your organization are you currently employed?
5. On a scale of 1 to 10, how familiar are you with the concept of Artificial Intelligence (AI)?
6. Please indicate the extent *(Agree, Not sure, Disagree)* to which you agree or disagree with each of the following benefits of using AI in state budget planning:
    a. *Greater transparency in financial decision-making.*
    b. *Human error risk reduction.*
    c. *Improved budgeting cycle time management via AI permanent availability.*
    d. *Enhanced efficiency in resource allocation due to processes automation.*
    e. *Better identification of cost-savings opportunities and revenue projections via improved data governance.*
7. Please indicate the extent *(Agree, Not sure, Disagree)* to which you agree or disagree with each of the following risks of using AI in state budget planning:
    a. *AI solutions lack outside of box thinking.*
    b. *AI-based tools maintenance costs are high.*
    c. *AI solutions lack ethics.*
    d. *AI can never guarantee to hit the most optimal solution.*
    e. *AI can provoke an increase in unemployment level.*
    f. *AI regulatory framework is in its infant phase.*

8. Do you believe that implementing AI in state budget planning could lead to more accurate financial forecasts?
    a. *Yes*
    b. *No*
    c. *Not Sure*
9. Please indicate to what extent *(Agree, Not sure, Disagree)* are budget components highlighted below likely to be improved by AI:
    a. *Data collection.*
    b. *Data representation and reporting.*
    c. *Financial analysis.*
    d. *Trend and pattern recognition.*
    e. *Proposing different scenarios.*
    f. *Regular updates and reviews.*
    g. *Budget harmonization (consider more opinions, demands and expectations of different stakeholders).*
10. What do you perceive as the biggest challenges or drawbacks of implementing AI in state budget planning?
11. How receptive do you think the public and policymakers would be to the use of AI in state budget planning?
    a. *Very receptive.*
    b. *Somewhat receptive.*
    c. *Neutral.*
    d. *Somewhat resistant.*
    e. *Very resistant.*
12. On a scale of 1 to 10, how important do you think it is for government agencies to invest in AI technologies for improving budget planning processes?
13. Would you support pilot programs or trials to be shared with you to test the effectiveness of AI in state budget planning before full-scale implementation?
14. What disclosure and educational procedures must be carried out among country residents before implementing AI in the state budget planning?
15. What specific features or capabilities would you like to see in an AI system designed for state budget planning?

Pearson Correlations

Correlations

		Awareness	Potential
Awareness	Pearson Correlation	1	.305**
	Sig. (2-tailed)		.002
	N	104	104
Potential	Pearson Correlation	.305**	1
	Sig. (2-tailed)	.002	
	N	104	104

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2. Pearson Correlation between AI Awareness *(Q5)* and AI Potential *(Q8)*

Correlations

		Investment	Potential
Investment	Pearson Correlation	1	.382**
	Sig. (2-tailed)		<.001
	N	104	104
Potential	Pearson Correlation	.382**	1
	Sig. (2-tailed)	<.001	
	N	104	104

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 3. Pearson Correlation between AI Potential *(Q8)* and Need to Invest in AI *(Q12)*