TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Alesi Esmeralda Ruiz 233909IVGM

Barriers and Enablers of Implementing AI Enabled E-Government Services: Case Study of BüroKratt

Master's thesis

Supervisor: Ermo Taks

Katrin Merike Nyman-Metcalf

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Alesi Esmeralda Ruiz 233909IVGM

AI-toega e-valitsuse teenuste rakendamise takistused ja voimaldajad: BüroKratti juhtumiuuring

magistritoo

Juhendaja: Ermo Taks

Katrin Merike Nyman-Metcalf

Tehnikateaduse magister

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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.

Author: Alesi Esmeralda Ruiz

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Abstract

This thesis explores the barriers and enablers of AI implementation in public services through a qualitative case study of BüroKratt, Estonia's national virtual assistant. Using eight stakeholder interviews and guided by the TOE framework, DOI, Institutional, and Stakeholder Theory, the study identifies key socio-technical and institutional dynamics. Findings show that while Estonia's digital infrastructure and strategic ambition support innovation, challenges such as data limitations, resource constraints, and governance misalignment impact delivery. The study offers practical insights into future AI initiatives in e-government.

This thesis is written in English and is 52 pages long, including 7 chapters, and 4 tables.

Annotatsioon

Al-toega e-valitsuse teenuste rakendamise takistused ja voimaldajad: BüroKratti juhtumiuuring

See uurimustöö käsitleb tehisintellekti (AI) rakendamise takistusi ja võimaldajaid avalikes teenustes, kasutades kvalitatiivset juhtumiuuringut BüroKrattist, Eesti riiklikust virtuaalsest assistendist. Kaheksa sidusrühma intervjuu ja TOE raamistiku**,** DOI**,** institutsionaalse ja sidusrühmade teooria abil tuvastab uuring peamised sotsiaal-tehnilised ja institutsionaalsed dünaamikad. Tulemused näitavad, et kuigi Eesti digitaalne infrastruktuur ja strateegiline ambitsioon toetavad innovatsiooni, mõjutavad elluviimist sellised väljakutsed nagu andmepiirangud, ressursipuudus ja haldamise ebakõlad. Uuring pakub praktilisi teadmisi tulevaste tehisintellekti initsiatiivide jaoks e-valitsuses.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 52 leheküljel, 7 peatükki, 4 tabelit.

List of abbreviations and terms

AI	Artificial Intelligence
LLM	Large Language Model
TOE	Technology-Organization-Environment (Framework)
DOI	Diffusion of Innovations (Theory)
OECD	Organization for Economic Co-Operation and Development
EU	European Union
RIA	Riigi Infosüsteemi Amet (Estonian State Information System Authority)
ICT	Information and Communication Technologies
G2C	Government to Citizen
G2G	Government to Government
G2B	Government to Business
G2CS	Government to Civil Society
NLP	Natural Language Processing
CEO	Chief Executive Officer (only if mentioned)
CTO	Chief Technology Officer
EU AI Act	European Union Artificial Intelligence Act (contextually implied)

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1 Introduction

1.1 Background and Context

Advancements in digital technologies are reshaping how governments interact with citizens, businesses, and other stakeholders. Digital transformation in the public sector aims to enhance the accessibility, efficiency, and responsiveness of public services (European Parliament and Council of the European Union, 2022; Al-Besher & Kumar, 2022). As part of this transformation, e-government initiatives are increasingly leveraging technologies such as cloud computing, data analytics, and artificial intelligence (AI) to modernize service delivery and improve user experiences. The European Union's Digital Decade Policy Programme 2030 emphasizes this shift, stating that "every citizen and business should be able to interact digitally with public administration" (European Parliament and Council of the European Union, 2022, p. 8).

Among the most transformative digital technologies is AI, which holds significant potential for automating routine administrative processes, personalizing services, and enabling round the clock access to government functions. AI applications such as chatbots and large language models (LLMs) are being adopted in various public sector contexts in order to reduce response times, lower operational costs, and improve service quality (Al-Besher & Kumar, 2022). Recognizing these benefits, governments across Europe are actively exploring how AI can enhance public service provision (Agustina Brizuela et al., 2024).

According to the European Commission's Public Sector Tech Watch, more than 900 AI use cases had been identified in the EU by 2024, with a substantial share focused on public services (Agustina Brizuela et al., 2024). Estonia, in particular, stands out as a digital frontrunner, contributing 59 AI use cases. Successfully positioning itself as a leader in AI-driven public innovation.

At the forefront of Estonia's AI strategy is BüroKratt. It is a pioneering AI-powered virtual assistant developed to facilitate seamless access to government services. BüroKratt's aim is to operate as an interoperable network of AI chatbots integrated across multiple public sector websites, providing citizens with a single conversational interface to interact with government agencies (Bürokratt, n.d.; Lopes Goncalves, 2022). Initiated under Estonia's National AI Strategy 2019–2021, BüroKratt exemplifies a long-term vision to embed AI within the broader framework of digital governance (Lopes Goncalves, 2022; Agustina Brizuela et al., 2024).

BüroKratt is more than a technical tool; it reflects a broader shift towards AI-enabled governance that challenges traditional bureaucratic models (Lopes Goncalves, 2022). While Estonia's advanced digital infrastructure and strong political commitment have facilitated the deployment of BüroKratt, the initiative also highlights key challenges facing AI implementation in the public sector. These include the integration of new

technologies into legacy systems, organizational readiness for digital transformation, evolving regulatory requirements, and the need for inclusive stakeholder engagement (Agustina Brizuela et al., 2024).

Understanding the barriers and enablers that shape the adoption of AI in e-government, both in pioneering contexts like Estonia and in broader international efforts, is essential for informing future public sector innovation. BüroKratt serves as a timely and relevant case study for exploring how AI can be effectively implemented in public services. Also to explore what institutional, organizational, and technological conditions are necessary to support this transition.

1.2 Research Problem, Significance and Objectives

While AI-enabled services such as BüroKratt offer promising benefits for improving public sector service delivery, the path from concept to implementation is far from straightforward. Governments face multiple barriers, including technological uncertainties such as model reliability, data quality, and system interoperability (Wirtz et al., 2019; Sivarajah et al., 2017). Organizational challenges including leadership gaps, capability shortages, and resource constraints (Madan & Ashok, 2023). As well as regulatory pressures related to data privacy, ethics, and compliance with both national and European Union (EU) frameworks (Misuraca & Van Noordt, 2020).

Despite growing academic and policy interest in AI adoption in the public sector, much of the existing research focuses on high-level conceptual models, generalized benefits, or abstract risks (Madan & Ashok, 2023; Wirtz et al., 2019). While these contributions offer valuable theoretical insights, fewer studies provide empirical evidence on how public organizations operationalize AI adoption, or overcome real-world barriers during implementation (Sivarajah et al., 2017; Madan & Ashok, 2023). This gap limits the practical relevance of existing frameworks for policymakers and practitioners tasked with scaling AI in complex government environments.

This research gap is particularly evident in the European e-government context, where strategic initiatives such as the EU Digital Decade Policy Programme 2030 promote widespread AI adoption, but offer limited operational guidance on overcoming implementation challenges (European Parliament and Council of the European Union, 2022). While Estonia is internationally recognized as a digital governance leader (OECD, 2020), empirical research on how national flagship projects like BüroKratt navigate technological, organizational, regulatory, and stakeholder-related challenges remains scarce (Lopes Goncalves, 2022).

Objectives of the Study
In response to these gaps, this thesis sets out to achieve the following objectives:

Objective 1: Identify the barriers and enablers to implementing AI-enabled e-government services, using BüroKratt as an in-depth case study.

Objective 2: Compare the empirical findings with existing academic literature to validate, extend, or challenge current understandings of AI adoption in the public sector.

Objective 3: Develop practical strategies that help other AI initiatives that support the scaling and institutionalization of AI in public service delivery.

Through this analysis, the study seeks to contribute both theoretical insights by applying technology adoption frameworks, specifically the TOE Framework, DOI Theory, Institutional Theory, and Stakeholder Theory. Also to provide insights for policymakers, system designers, and public managers aiming to advance AI-enabled governance.

1.3 Research Questions

This study seeks to address the gap between high-level AI adoption models, and the practical realities of implementing AI in the public sector. Using BüroKratt as a case study, the research focuses on identifying the factors that enable, or hinder AI implementation in e-government services. Also, developing strategies to support future AI initiatives in the public sector.

To achieve these aims, the study is guided by the following research questions:

RQ1: What are the barriers and enablers to implementing AI-enabled e-government services, and how do the findings from the BüroKratt case compare with those identified in the existing literature?

RQ2: What strategies can be applied for other AI initiatives in e-government services?

These research questions are designed to contribute both theoretical insights by validating or extending existing technology adoption models. Practical recommendations for policymakers, system designers, and public sector leaders seeking to scale AI-enabled services will also be discussed.

1.4 Structure of the Thesis

This thesis is structured into seven chapters, each contributing to answering the research questions and achieving the stated objectives.

Chapter 1: Introduction
Provides the background, research problem, objectives, and research questions. This chapter positions the study within the broader context of digital government transformation and the emerging role of AI in public service delivery.

Chapter 2: Theoretical Framework
Presents the theoretical foundations of the study, including the TOE Framework, DOI Theory, Institutional Theory, and Stakeholder Theory. These frameworks are used to guide the literature review, inform data collection, and structure the analysis.

Chapter 3: Literature Review
Reviews relevant academic literature on e-government services, AI adoption in the public sector, and the socio-technical barriers and enablers that influence AI

implementation. The review is structured using the TOE Framework to categorize technological, organizational, and environmental factors.

Chapter 4: Methodology
Describes the qualitative research design, case study approach, participant selection, data collection via semi-structured interviews, and the thematic analysis process used to analyze the interview data.

Chapter 5: Results
Presents the empirical findings from the BüroKratt case study. The results are organized around the key barriers and enablers identified through thematic analysis and is framed by the theoretical dimensions of the study.

Chapter 6: Discussion
Interprets the findings in relation to the existing literature and theoretical frameworks. This chapter also proposes practical strategies that help other AI initiatives that support the scaling and institutionalization of AI in public service delivery.

Chapter 7: Conclusion
Summarizes the study's key findings and contributions to knowledge. It also outlines the study's limitations and offers suggestions for future research on AI adoption in the public sector.

2 Theoretical Framework

The theoretical framework for this study is built upon several well-established theories that provide a comprehensive understanding of the barriers and enablers of AI adoption in the public sector; specifically for e-government services. These theories include TOE Framework, DOI Theory, Institutional Theory, and Stakeholder Theory. Each theory contributes unique insights into the barriers and enablers of AI implementation and adoption, providing a multifaceted view of the research problem.

2.1 TOE Framework

The TOE framework, introduced by Tornatzky and Fleischer (1990) and further developed by Baker (2012), examines three critical dimensions: technological, organizational, and environmental factors. Technological factors include the characteristics of the technology being adopted, such as its complexity and compatibility. Organizational factors refer to the characteristics of the organization, including its readiness, internal resources, and structure. Environmental factors involve the external environment, including market conditions, regulatory frameworks, and societal expectations. Baker's (2012) work is particularly crucial as it solidified the framework's application in the study of technology adoption, emphasizing its adaptability across various domains, including public administration.

In the context of AI-enabled e-government services, TOE has been instrumental in identifying key barriers such as technological infrastructure limitations and data integration challenges (Hradecky et al., 2022; Mikalef et al., 2021). It also highlights enablers like digital infrastructure investment and organizational readiness, which are crucial for successful AI implementation (Fetais et al., 2022).

The TOE framework will be the primary lens for conducting the literature review on barriers and enablers of AI in the public sector. It provides a structured approach to understanding the multifaceted challenges and opportunities in AI adoption. Additionally, TOE will inform the development of interview questions, allowing for an exploration of the specific technological, organizational, and environmental factors at play in the BüroKratt context. Finally, TOE will guide the thematic analysis of the interview data, categorizing key insights into technological, organizational, and environmental dimensions.

2.2 DOI Theory

The Diffusion of Innovations (DOI) Theory, developed by Rogers (2003), is another key framework for understanding how innovations, such as AI technologies, are adopted within a social system. DOI focuses on factors that influence the rate and extent of adoption, including relative advantage, compatibility, complexity, trialability, and

observability. These factors help explain stakeholder behaviors, which includes their willingness to adopt AI technologies in e-government services.

Recent studies have applied DOI to analyze AI adoption in public sector organizations, focusing on factors like trust and the perceived benefits of AI (Madan & Ashok, 2023; Neumann et al., 2024). In the BüroKratt case study, DOI will inform the development of interview questions by addressing the factors that influence the stakeholders' adoption behaviors. It will also guide the thematic analysis of the interview data, helping to identify which attributes of AI, such as its perceived relative advantage, or compatibility with existing systems influence its acceptance and integration within the public sector organizations.

2.3 Institutional Theory

Institutional Theory provides a framework for understanding the influence of external pressures and organizational norms on technology adoption. According to DiMaggio and Powell (1983), organizations tend to adopt practices and technologies that align with the prevailing norms and structures within their field. This framework emphasizes coercive, normative, and mimetic pressures. This can significantly shape the adoption of AI technologies in public administration. In the case of AI adoption, coercive pressures might come from regulatory requirements. Normative pressures might emerge from professional standards, or societal expectations regarding AI ethics and governance.

Institutional theory has been used to explore the adoption of e-government innovations, highlighting the role of public policies and institutional norms in shaping technology implementation (Jun & Weare, 2011; Mergel et al., 2023). For the BüroKratt case study, Institutional Theory will inform the development of interview questions, allowing for an exploration of the institutional pressures. It will explore both external and internal pressures that influence AI adoption. It will also guide the thematic analysis by categorizing data related to institutional norms, regulatory frameworks, and societal expectations regarding AI adoption.

2.4 Stakeholder Theory

Stakeholder Theory, introduced by Freeman (1984), emphasizes the importance of considering the interests and influences of all the parties involved in or who are affected by an organization's actions. In the context of AI adoption in e-government, stakeholders include government officials, IT staff, citizens, and external vendors. This theory is particularly useful for understanding how various stakeholders interact, and how their interests shape the decision-making process regarding AI implementation.

Recent studies have applied stakeholder theory to analyse public sector innovations, such as AI, highlighting the importance of involving a wide range of stakeholders in the design, development, and deployment of new technologies (Boon et al., 2023; Bryson et al., 2015). In the BüroKratt case study, Stakeholder Theory will be used to guide the selection of participants for the case study interviews. It will be used to inform the development of interview questions by ensuring the inclusion of a wide range of stakeholders in the study. It will also guide the thematic analysis of the interview data,

categorizing insights based on the roles, interests, and influences of the different stakeholders involved in the AI adoption process.

2.5 Summary

In summary, the theoretical frameworks of TOE, DOI, Institutional Theory, and Stakeholder Theory collectively offer a comprehensive approach to understanding the barriers and enablers of AI adoption in e-government services. TOE provides a structured way to examine technological, organizational, and environmental factors. DOI and Institutional Theory deepen the analysis of stakeholder behaviors and institutional influences. Stakeholder Theory ensures that the perspectives of different groups are considered in the study, enabling a holistic understanding of the factors that shape AI adoption in the public sector. These frameworks will guide the literature review, the development of interview questions, and the thematic analysis of the BüroKratt case study. It will help to answer research questions and contribute to the academic understanding of AI adoption in government services.

3 Literature Review

3.1 E-Government and E-Services

As we journey through the digital age we find ourselves in, the public sector is experiencing a digital transformation. As a result, a core concept that filters through this digital transformation is that of e-government. The simplest definition we can use to define the characteristics of an e-government is one set by OECD. OECD describes e-government as the application of information and communication technologies (ICT), especially the internet, to improve the functions of government entities and the improvement of their interactions with citizens and businesses (OECD, 2003). This definition, however, only serves as a starting point. There are more nuances that emerge when trying to define what e-government represents today.

Technology is a tool that is used by humans, as such, e-government cannot just be defined by technology. E-government is a socio-technical transformation that requires public sector entities to rethink how they organize themselves. Along with this, they must rethink how they deliver their e-services and how they engage their citizens. For example, the European Commission (2005), describes e-government as an integration of ICT with organizational change and skills development to improve e-services, democratic governance, and policy effectiveness (Al-Balushi et al., 2016). Digital tools alone cannot transform governance. There must be a change that also extends to the structures of institutions, business processes, and the public administration mindset.

Therefore, e-government must not only be a technological endeavor, but an organizational one as well. Ultimately, as Scholl and Klischewski (2007) argue, real progress happens when there is a common purpose of improvement of the relationships

between the state and all of its stakeholders through the alignment of technology, policy and administration.

3.2 E-Government Services

The groups of primary stakeholders that services are designed to serve, also serve as the basis to classify e-government services. As such, these classifications provide a structure to understand the goals and beneficiaries of digital government initiatives. The classifications of e-government services are as follows.

The first classification is Government to Citizen (G2C). Axelsson, Melin, and Lindgren (2013) explain that this classification is focused on citizen-centered e-services which aim to improve the access and benefits for users. Similarly, the OECD (2003) highlights how online services can enhance government-citizen interactions. G2C e-services, therefore, are services that are focused on improving not only the quality, but also the accessibility of e-services for citizens. Some examples of this are: online tax filings, healthcare portals, and digital identity management. Although Kunstelj and Vintar (2004) do note that G2C e-services often serve as a starting point for many e-government strategies, it remains a challenge for many countries to progress from basic informational e-services to fully transactional or integrated digital services.

The second classification is Government to Government (G2G). Yildiz (2007) describes G2G as an administrative coordination which involves communication, coordination, and standardization. Scholl and Klischewski (2007) explain that G2G e-government services heavily depend on process integration and interoperability in order to allow government entities to share data and streamline workflows. This becomes particularly relevant in the context where there are multiple agencies collaborating to deliver both complex and cross-sectoral digital services (Al-Balushi et al., 2016). G2G e-services therefore are services that focus on improving information sharing and coordination across e-government systems and agencies. Their aim is to enhance administrative efficiency by reducing duplicated efforts and enabling digital service delivery that is integrated.

The third classification is Government to Business (G2B). Yildiz (2007) describes G2B e-services as digital services that facilitate communication, collaboration, and commerce between government and businesses. To further this, the OECD (2003) highlights procurement portals as models for streamlining B2G interactions. G2B e-government services, therefore, are digital services that focus on streamlining the interaction between businesses and the state in order to reduce administrative burdens and facilitate regulatory compliance. Some examples are licensing, electronic procurement, and business registration (OECD, 2003; Scholl & Klischewski, 2007).

The fourth classification is Government to Civil Society (G2CS). Yildiz (2007) expands the traditional models in order to include civil society organizations that promote transparency, coordination, and collaboration beyond market actors and government by introducing G2CS. This expansion is important as Axelsson et al. (2013) emphasize that including civil society as a distinct stakeholder group is essential for ensuring that e-government strategies serve the broader public interest, and not just administrative efficiency. G2CS e-service, therefore, are digital services that extend the reach of e-

government to include partnerships with non-governmental organizations, civic groups, and other community actors. The aim of these digital services is to strengthen democratic engagement through the support of collaboration with civil society in areas such as policy consultation, digital public service co-design, and advocacy (Yildiz, 2007)

3.3 Scope of E-Government

Depending on how deeply e-services are integrated, the scope of e-government also varies. Some governments offer only static information on their websites. Other governments, such as Estonia, have achieved highly integrated, and interoperable digital ecosystems that allow citizens to access e-services through a single digital identity. As the OECD (2003) notes, "*the Internet can help achieve this goal, by enabling governments to appear as a unified organisation and provide seamless online service"* (p. 46). Estonia's X-Road platform and digital identity framework showcases this level of integration as it provides citizens with secure single-point access to their wide range of e-services (OECD, 2003).

It is this integration that would allow users to apply for social benefits or start a business without forcing them to navigate fragmented e-government systems. The integration of these e-services is therefore designed to meet the real-life needs of individuals. Scholl and Klischewski (2007) describe this as the ideal state where *"citizens and businesses alike access whatever government service they need through a single gateway (or portal), which integrates every aspect of that particular G2C or G2B transaction or interaction"* (p. 890). These types of e-service models require governments to move beyond basic information e-services and move toward transactional and life event-oriented e-services. Kunstelj and Vintar (2004) argue that advancing e-government services requires the rethinking of internal structures and processes to better reflect user needs in order to make it possible to progress beyond basic online interactions toward a fully integrated e-services delivery.

It is, however, important to highlight that such success stories are the exception and not the rule. A great illustration of this are the comparative studies by Oleśków-Szłapka and Przybylska (2008) and Al-Balushi et al. (2016) which exemplify that there are many governments that continue to face difficulties in progressing beyond the early stages of providing basic information online. For example, according to Oleśków-Szłapka and Przybylska (2008), Poland lags behind the EU average in terms of citizen adoption of e-services as relatively few users access information, or submit forms through government websites. They attribute this limited uptake to structural challenges which include bureaucratic institutional cultures and fragmented administrative practices. They argue that it is this that hinders more advanced digital transformation efforts.

Quite similarly, Al-Balushi et al. (2016) identify the key challenges that constrain Oman's e-government development to organization, technological, and strategic barriers. They acknowledge that a technical infrastructure is essential for the implementation of an e-government. However, they argue that many government agencies in Oman lack coherent strategies and frameworks to be able to fully leverage ICT or AI-based solutions. As a result, challenges such as fragmented leadership, resistance to organizational change, limited ICT capacity and low levels of digital

literacy have hindered the progress of delivering more integrated and user-centered e-services (Al-Balushi et al., 2016).

3.4 Goals of E-Government

The main goal of an e-government is to make e-services better. At first glance, this goal may seem simple, however, achieving this goal requires the balancing of multiple priorities which can often be competing with one another. The key goals identified in the literature are as follows: enhancing the service delivery, the improvement of government efficiency, the promotion of democratic engagement and transparency, and driving both institutional and cultural transformation.

Enhancing Service Delivery
One of the aims of e-government is to make e-services more accessible, more convenient, and faster. Scholl and Klischewski (2007) emphasize that a core of e-services is providing citizen-centric, and seamless services that improve convenience, accessibility, and efficiency. They describe e-services that can be accessed through a single integrated portal rather than fragmented channels in order to reduce friction, increase speed, and ensure that service delivery has more meaningful outcomes. This goal is very much in line with the approach that Estonia has taken. Estonia designs e-services that are user-centered by making them easy to understand, simple to use and accessible at key moments in life whether it is to find a job, manage health, or relocation (E-teenuste disainimise käsiraamat, 2021).

Improving Government Efficiency
Although user experience is important, e-government also seeks to improve the internal functioning of the public administration. Scholl and Klischewski (2007) argue that digitizing front-end e-services is not the only requirement to achieve efficiency. They argue that it also requires back-end integration and interoperability in order to reduce redundancies, lower costs, and to improve coordination across government agencies. It is further highlighted by Osman et al. (2019) that data driven management frameworks enable public institutions to allocate resources more effectively, enhance organizational agility, and optimize processes. This goal is also very much in line with the integrations that Estonia has accomplished. Recently, Estonia has launched a government cloud service which would facilitate back-end integration and interoperability (*Estonian Public Sector Opens Door to Public Cloud Services | RIT*, n.d.). It is also important to note that Estonia has greatly increased interoperability with XRoad, which facilitates data exchange. (*Data Exchange Layer X-Tee | RIA*, n.d.)

Promoting Democratic Engagement and Transparency
E-government has the potential of bringing citizens closer to governments not just as a service provider but as democratic institutions. According to Yildiz (2007), digital government initiatives promote transparency, encourage public participation, and improve accountability; thereby it strengthens democratic values. This is supported using tools such as open data platforms, online consultations, and participatory decision-making channels as they provide citizens with new opportunities to engage directly with public administration. Janssen and van der Voort (2016) add that digital platforms help in the reduction of the information gap between citizens and

governments. This reduction enables more collaborative and transparent government practices.

Driving Institutional and Cultural Transformation
Finally, e-government is a catalyst which spurs the rethinking of how governments operate. The OECD (2003) emphasizes that successful digital transformation is dependent not only on technological investments, but also on building institutional capacity, fostering cross agency cooperation, and securing political leadership. Scholl and Klischewski (2007) warns that only focusing on technological wins without addressing the deeper organizational and governance barriers often leads to either limited or failed implementations. Kunstelj and Vintar (2004) quite similarly stress that to achieve both meaningful and lasting change, public administrations are required to move beyond surface level digitalization. It is essential to undertake structural reforms that reshape workflows, responsibilities, and administrative cultures.

It is easier to articulate these goals than it is to achieve them in practice. Many governments continue to prioritize quick technological fixes such as launching new portals or digitizing forms, but they do not address the deeper organizational, process, and governance changes that are needed for true digital transformation (Kunstelj & Vintar, 2004; Yildiz, 2007). In order to move beyond these limitations, long term commitment, strategic investment in people and processes, but most importantly the willingness to design e-services for the people they are intended to serve is required (Axelsson et al., 2013; E-teenuste disainimise käsiraamat, 2021).

3.5 AI in E-Government and E-Services

Building on the goals of e-government, governments around the world are increasingly turning to AI as more than just a technological upgrade. According to Hjaltalin and Sigurdarson (2024), national AI strategies position AI not just as a tool for automation, but as a strategic enabler of public sector transformation. It is these strategies that highlight the potential AI has in reshaping governance structures, enhancing decisions that are driven by data, and improving the way citizens experience digital public services. Similarly, Mikhaylov et al. (2018) emphasize that AI is transforming not only internal government processes but also redefining relationships across sectors. They describe AI as a catalyst for new forms of collaboration between government institutions, private sector partners, and civic organizations. It is this cross-sector engagement that is driving governments to reimagine their interactions with both citizens and service providers. They do so by positioning AI as a driver for institutional innovation and creating public value.

Within this context, AI encompasses computational methods which are aimed at performing tasks that would traditionally rely on human intelligence. These functions typically include tasks such as information processing, supporting the decision-making process, and the personalization of service. AI applications commonly make use of techniques such as machine learning, natural language processing, and other data-driven methods to enable the delivery of automated and intelligent e-services (Hjaltalin & Sigurdarson, 2024).

Although AI is often viewed as an advancement in technology, it offers e-government far more than just a set of new tools. AI is an enabler of capabilities such as automation, predictive analytics, and human-like interaction. What is more, it has the potential to improve service delivery that is scalable. Making use of these potential benefits, however, requires governments to navigate technological complexity, build organizational capacity, and address regulatory and ethical challenges (Desouza et al., 2020). If these capabilities are not carefully managed, they risk undermining public trust or reinforcing existing inequalities.

As Mergel et al. (2023) argue, AI acts as a strategic driver of e-government transformation by helping governments move beyond digitization and move toward reimagining how services are not only designed, but how they are delivered and experienced. However, understanding this strategic role is only a part of the picture. In order to fully grasp how AI is transforming e-government, it is also important to explore the technologies that are driving this change.

3.6 AI as an Enabler of E-Government Innovation and Transformation

In a world that is increasingly more digital, e-government is facing growing pressure to rethink how they deliver services. AI was once seen as little more than a promising technological advancement but has now emerged as a force that is strategic and is capable of driving meaningful transformation within e-government (Hjaltalin & Sigurdarson, 2024). It is not limited to automation or cost reduction, AI has opened new possibilities that can reshape how governments make decisions, organize e-services, and build relationships with citizens and other stakeholders (Mergel et al., 2023).

When the lens of Diffusion of Innovation (Rogers, 2003) is applied, AI stands out as a powerful agent for change. It not only accelerates the adoption of digital tools, but it also accelerates the shift in organizational mindsets that are imperative for true transformation to happen (Hjaltalin & Sigurdarson, 2024). This becomes more than just about technology. It becomes about changing how the government works at a deeper, more profound level.

The real value of AI is that it has the ability to process massive amounts of data and do so very quickly. This allows governments the ability to work with information at a scale that was once out of reach. AI also makes it possible for governments to spot patterns that traditional systems often miss. On top of that, it can support complex decision-making in ways that older technologies struggle to attempt, much less achieve (Al-Besher & Kumar, 2022; Chen et al., 2023).

A good example of these types of e-government tools would be virtual assistants and AI-powered chatbots. Tools such as these are being increasingly used in order to simplify things such as citizen interactions by answering questions, and guiding users through processes which aid the reduction of the burden currently placed on human staff (Oksama et al., 2024; Tueiv & Schmitz, 2023). It is not just the technical sophistication that makes these types of tools so promising, but it is their ability to make e-services feel more accessible and human.

Although citizen-facing services play a big role, AI also plays an increasing role behind the scenes. For instance, predictive analytics allow governments to anticipate things such as demand for services by allowing the allocation of resources more effectively, and tackling issues such as fraud, or welfare eligibility with greater precision (Al-Besher & Kumar, 2022; Chen et al., 2023). It is these capabilities that help e-services move from being reactive to being proactive and responsive. Ultimately, it is this shift that improves outcomes attained by both citizens and governmental agencies.

However, it is important to point out that none of this is free of challenges. AI demands that there be deep organizational changes, it calls for ethical oversight and strong leadership when implementing AI in e-government (Henman, 2020; Mergel et al., 2023; Desouza et al., 2020). Eroding public trust or reinforcing already existing inequalities are risks that AI carries if there are no clear governance frameworks. The questions around fairness, transparency, and accountability are not just a theoretical exercise, they are real concerns that governments must address if they are to use AI responsibly (Chen et al., 2023; Henman, 2020).

AI offers promise as well as responsibility. It allows governments the unique opportunity to be able to design e-services that are more innovative and citizen centric. However, public institutions must be prepared to lead with care, collaborate across sectors, and ensure that these technologies truly serve the public good if this promise is to be realized (Hjaltalin & Sigurdarson, 2024; Mikhaylov et al., 2018).

3.7 Value and Types of AI Used in E-government and E-Services

AI is not made up of a single technology, but is a collection of digital tools and techniques that offer different kinds of value to e-government and e-services. These applications not only perform specific technical functions, but they also support broader goals such as the improvement of accessibility, the increase of efficiency and the strengthening of public trust. This section explores the key types of AI used in e-government and highlights the value they bring to citizens, organizations and government.

Natural Language Processing and Conversational Agents

One of the most occurring uses of AI in e-government is the use of NLP. This type of technology allows systems to both process and understand human language. It enables the powering of tools such as chatbots and virtual assistants which has led many governments to use it in order to manage interactions with citizens (Oksama et al., 2024; Tueiv & Schmitz, 2023). These tools can handle routine questions, they can also provide information and they can guide individuals through the navigation of e-services. This reduces pressure on human staff and makes e-services more accessible.

Estonia's BüroKratt serves as a great example of this. BüroKratt allows citizens to interact with the state through one unified digital assistant as it connects services across different government agencies into a single conversational interface (Dreyling et al., 2022). From a technology and organizational perspective, these types of solutions are relatively easy to scale when they are supported by strong e-government infrastructure.

It is still important to note that it requires governments to coordinate across agencies which can be a significant organizational challenge.

Apart from improving operational efficiency, these types of tools also support the building of public trust as they make government interactions feel more human, transparent and approachable. It strengthens the perception of government being responsive and citizen orientated when citizens can easily access information or complete tasks without barriers (Dreyling et al., 2022; Oksama et al., 2024).

Predictive Analytics for Smarter Decisions

Behind the scenes, AI is playing a growing role, particularly through predictive analytics. This type of AI uses data in order to forecast outcomes, or to identify risks. Public agencies apply it in areas such as fraud detection, public health, and social welfare eligibility (Al-Besher & Kumar, 2022; Chen et al., 2023). Another example Henman (2020) details is that predictive models can help flag claims that are potentially fraudulent which allows investigators to focus their efforts where they are most needed. This type of AI helps improve efficiency and also supports more targeted and responsive service delivery.

These types of applications very often demand higher technological and organizational capacity including access to high quality data and the expertise in order to interpret the results. They also operate in a sensitive regulatory environment where decisions must be transparent, fair, and legally compliant. Chen et al. (2023) warn that AI systems that operate without appropriate oversight carry the risk of reinforcing biases or produce errors that could negatively impact vulnerable groups which could potentially decay trust in public services.

While these tools primarily support back-end efficiency, they also benefit citizens by enabling governments to respond more proactively to emerging needs, such as predicting service demands or targeting social support more accurately (Al-Besher & Kumar, 2022; Chen et al., 2023). In order to maintain public trust, it is essential to ensure fairness, transparency, and explainability in these processes (Henman, 2020; Mergel et al., 2023).

Generative AI and Large Language Models

In more recent studies, the use of AI tools includes Generative AI and LLMs. These tools do more than just answer questions or spot trends. They have the ability to generate human-like text, summarize reports, and draft policy recommendations (Austin et al., 2024; Bright et al., 2025). These types of tools are starting to be explored by governments for document automation, knowledge management and citizen communication (Androniceanu, 2024; Bright et al., 2025).
These applications promote scalability and operational efficiency, but they come with complex governance challenges. They are requiring organizations to manage technological risks such as misinformation and bias, and to navigate ethical concerns about accuracy and accountability (Chen et al., 2023; Bright et al., 2025). In addition to this, the organizational readiness, which includes leadership, training and cross-agency collaboration, is essential in order to ensure these tools are used effectively and responsibly (Desouza et al., 2020; Mergel et al., 2023).

From the user perspective, these tools can help make complex information more understandable, which improves communication between citizens and government. Bright et al. (2025) report that many public sector professionals already experiment with generative AI in order to draft communications and summarize documents which may help make government information more accessible. Similarly, Androniceanu (2024) highlights the role of generative AI in supporting inclusiveness by improving communication flows and the handling of documents in public administration. However, these benefits must be balanced against the risk of misinformation, or loss of accountability if AI-generated content is not properly monitored (Chen et al., 2023; Mergel et al., 2023).

All of these examples exemplify that AI does not exist in isolation. They also illustrate that the value of AI in e-government and e-services extends beyond automation and efficiency. It includes the enhancement of user experience, the improvement of fairness and accessibility, and it builds public trust when used transparently and responsibly (Hjaltalin & Sigurdarson, 2024; Chen et al., 2023). Being able to realize this value, however, is contingent on whether governments have the institutional capacity, leadership, and governance frameworks required to manage AI ethically and responsibly.(Mikhaylov et al., 2018; Desouza et al., 2020).

3.8 Barriers and Enablers to AI Implementation in E-Government

While there is little doubt that AI holds great promise for improving e-government services, it remains challenging to translate this potential into practice. Governments around the world are experimenting with AI in order to enhance efficiency and user experience. However, many of these initiatives struggle to move beyond isolated pilots or limited applications. Academic studies have identified a wide range of barriers that contribute to this gap which include technological, organizational, legal, and societal changes (Wirtz et al., 2019; Totonchi, 2025; van Noordt et al., 2025; Mergel et al., 2023). Despite growing policy attention and technological advancements, these unresolved issues make it significantly difficult for governments to achieve large-scale integrated AI adoption in e-services.

If governments seek to translate AI's potential into meaningful outcomes, it is essential to understand the barriers and enablers that shape AI implementation in e-government, not just as a theoretical exercise. This particularly holds true for complex e-services that require technologies, organizational structures, policy frameworks, and user needs to be fully aligned. As Mergel et al. (2023) emphasizes, the success of AI not only depends on technical performance, but it depends as much on governance, leadership, and organizational capacity. This is also echoed by Misuraca & van Noordt (2020) as they argue that policy initiatives must go beyond deployment of technology and address regulatory clarity, cross-agency coordination, and public trust.

The academic literature identifies a wide range of socio-technical factors that allow the adoption of AI in e-government, or hinder it. These factors touch on multiple levels which include: technological infrastructure, organizational readiness, regulatory framework, and citizen engagement (Desouza et al., 2020; Wirtz et al., 2019; Mikhaylov et al., 2018). Some studies explicitly focus on overcoming technical

challenges such as data quality and system interoperability (Totonchi, 2025). Other studies, however, highlight the political, institutional, and cultural barriers that shape how AI is perceived, governed, and applied across government agencies (Neumann et al., 2024; Mergel et al., 2023).

Building on this body of research, the following literature review organizes these barriers and enablers using multiple analytical lense TOE Framework. This section lays the groundwork for comparing the BüroKratt experience with broader trends in the literature. This comparison will help assess whether BüroKratt's journey aligns with or challenges existing assumptions about AI implementation in e-government, and what practical lessons can be drawn for shaping future AI enabled e-services.

3.9 Technological Barriers and Enablers (TOE)

Technological capacity is one of the most commonly cited barriers in implementing AI in e-government. A recurring issue in the literature is the data quality, data availability and data management. Wirtz et al. (2019) argue that "...data quality and integration is of high importance because the AI system is only as smart as the provided data from which it learns" (p.602). Therefore, low quality or fragmented data can significantly undermine the accuracy of AI applications. Similarly, Millan-Vargas et al. (2024) highlight that interoperability is a key challenge when integrating large datasets in real time which can hinder accurate decision making (p. 84). Guedes and Moacir Oliveira (2024) add that confidentiality concerns and poorly managed data lifecycles pose legal and technical barriers, particularly when external vendors are involved. They also highlight "...the necessity for the systematic management of data from acquisition to disposal, ensuring accuracy, availability, and integrity throughout the AI application's lifecycle," (Guedes & Moacir Oliveira, 2024, p. 13).

In addition to data quality, IT infrastructure readiness is a critical factor. Tomaževič et al. (2024) highlight that a mature digital infrastructure is needed for AI adoption, "less digitally mature organizations may need to first update their existing IT systems to make them compatible with new AI technologies" (p. 126). Fetais et al. (2022) details "[AI adoption] requires a technical infrastructure to support staff and end-users with enough connectivity, bandwidth, processing power, and storage" (p. 4). Hradecky et al. (2022) specifically point to 5G connectivity as an emerging technological enabler, allowing e-governments to leverage real-time AI services and IOT applications. However, many organizations still operate on outdated systems that are poorly suited to AI integration. Schöll and Klischewski (2007) caution that legacy IT systems, which are often fragmented across different agencies, create structural barriers that complicate interoperability and system modernization efforts.

Data silos represent another frequently mentioned technological obstacle. Sivarajah et al. (2016) explain that government agencies often maintain isolated data warehouses built on incompatible platforms, making it difficult to share data across agencies "sharing data and information between distant organizations (or departments) is a challenge…each organization and their individual departments typically own a disparate warehouse (developed based on different technological platforms and vendors" (p. 275). This lack of interoperability is further exacerbated by inadequate data management practices, as noted by Selten and Klievink (2023), who stress the need for renewed IT

structures, improved collaboration between data teams, and updated procedures for logging and error management specific to AI.

Despite these barriers, the literature also identifies several technological enablers. Interoperability and Cloud Based Infrastructure, if achieved, is a game changer. (Dreyling III et al., 2024) highlight that system interoperability is the perfect ecosystem for AI adoption in e-government services. They also point out “a government cloud implementation of the IT infrastructure…lowers the necessary technical competence to ease adoption” (p. 738). It is also echoed by Sivarahah et al. (2016) that scalable cloud-based infrastructure can help public organizations manage data growth and processing demands by providing a more flexible foundation for AI deployment. However, they also point out that it can carry high costs for organizations to implement it. Desouza et al. (2020) further advocate for the development of interagency collaboration platforms, which facilitate data sharing across government departments-an essential condition for scaling AI beyond isolated pilots.

Finally, Millan-Vargas et al. (2024) emphasize the value of running proof-of-concept projects during a discovery phase to identify viable AI applications before scaling them, highlighting a structured approach to overcoming technological uncertainty.

These studies demonstrate that AI adoption comes with significant technological hurdles which must be addressed if e-governments hope to implement AI enabled services. This is especially true if e-governments hope to achieve sustainable and large-scale implementation. However, the studies also demonstrate that technology can provide e-governments with the tools to pilot and launch AI enabled e-services.

3.10 Organizational Barriers and Enablers (TOE)

Organizational capacity is widely recognized in the literature as a decisive factor in determining whether AI initiatives in e-government move beyond pilot phases to achieve meaningful scale. One of the most frequently cited enablers is leadership commitment and strategic vision. Selten and Klievink (2023) emphasize that "organizing leadership support is critical to the success of AI innovation" (p.7). However, they caution that while senior management may express general support for AI, "it still takes extra effort to initiate the necessary organizational and technical changes because operational managers often lack technical expertise on how and where to apply advanced forms of AI", particularly in complex domains such as natural language processing (Selten & Klievink, 2023, p. 7). Tomaževič et al. (2024) further highlight the importance of leadership in fostering a culture that embraces technological change, supports cross-unit collaboration, and promotes knowledge transfer. Fetais et al. (2022) reinforce these observations, noting that “top management support and a supportive regulatory environment lie at the bottom of the hierarchy, indicating that these enablers are the most important drivers facilitating AI adoption in e-government” (p. 12). Their findings suggest that the ability of leadership to allocate resources, influence policies, and overcome organizational inertia is essential for scaling AI beyond isolated initiatives.

Despite these enablers, a lack of AI expertise and technical skills remains a critical barrier in many public organizations. Van Noordt et al. (2022) identify capability gaps

as a recurring issue across European governments, where technical knowledge about AI's implementation and governance is limited. Tomaževič et al. (2024) similarly stress that building staff competencies through training and capacity development is essential for overcoming skill shortages. Without this investment in human capital, organizations risk becoming influenced by external vendors (Guedes & Moacir Oliveira, 2024).

Another significant organizational barrier is resistance to change, particularly in risk-averse bureaucratic environments. While not always labeled as such, Tomaževič et al. (2024) point out that an organization's cultural readiness, specifically, its willingness to engage with AI's risks and opportunities is a determining factor in whether adoption efforts succeed or stall. This cultural dimension is often linked to siloed organizational structures and poor collaboration. Van Noordt et al. (2022) note that difficulties in data sharing between departments and agencies frequently undermine AI's potential to improve services, as access to cross-organizational data is critical for developing accurate AI models.

Organizational procurement and bureaucracy hurdles present additional obstacles. Van Noordt et al. (2023) argue that traditional procurement processes are often ill-suited to the needs of AI projects, which require iterative development, agile contracting, and access to specialized expertise. Current public procurement rules tend to favor rigid, cost-focused evaluations over innovation-friendly approaches, making it difficult for government agencies to partner effectively with AI vendors.

In terms of ethics and accountability concerns, Wirtz et al. (2019) identify AI ethics as one of the four major categories of challenges in the public sector, alongside technology, law, and societal issues. Van Noordt et al. (2022) similarly highlight that questions about fairness, transparency, and accountability remain largely unresolved in many government AI projects. These concerns are particularly pressing in public services, where the stakes of algorithmic decision-making can affect citizens' rights and access to services.

Finally, organizational readiness and inter-organizational collaboration are highlighted as critical enablers. Tomaževič et al. (2024) outline that readiness extends beyond leadership to include technical infrastructure, employee skills, and cross-unit collaboration. They argue that both intra-organizational (within departments) and inter-organizational (across agencies and with private partners) collaboration are necessary to leverage collective expertise and data assets. Fetais et al. (2022) add that a supportive regulatory environment can further strengthen organizational readiness by encouraging responsible AI experimentation while providing policy clarity.

3.11 Environmental Barriers and Enablers (TOE)

Environmental barriers to AI adoption in e-government services primarily stem from challenges related to regulatory uncertainty, overregulation, and concerns about public trust. Regulatory uncertainty or overregulation is one of the most pressing issues, as highlighted by van Noordt & Misuraca (2022), who discuss how existing legal restrictions, such as privacy legislation, can severely hinder the implementation of AI technologies in the public sector. Public procurement regulations are often ill-suited for stimulating innovation in AI adoption, as they typically require more flexible,

innovative processes (Noordt & Misuraca, 2022). Mikalef et al. (2021) similarly note that regulatory guidelines can impede AI development in municipalities, as these regulations can create strict operating frameworks that stifle flexibility. This lack of flexibility can hinder the ability of public organizations to access critical data resources or limit the reuse of valuable data (Mikalef et al., 2021, p. 10).

Additionally, the lack of a supportive and clear regulatory framework poses a significant challenge. Van Noordt et al. (2025) argue that although some national AI strategies emphasize the potential of AI, these policies are often hindered by gaps in implementation, such as insufficient legal clarity and underdeveloped standards for AI deployment. Governments face a difficult task in balancing innovation and regulation, which further complicates efforts to push AI initiatives beyond small-scale trials. Van Noordt et al. (2025) specifically mention that AI strategies are sometimes "unrealistic funding strategies" without clear direction on whether investment is intended for research, the private sector, or the public sector, which limits effective implementation (Noordt et al., 2025, p. 244).

Public distrust and ethical concerns also significantly impact AI implementation in e-government. As Noordt & Misuraca (2022) point out, public administrations are hesitant to embrace AI when there are concerns over privacy, algorithmic bias, and transparency. These ethical dilemmas are compounded by the fear that AI decision-making processes may lack accountability, which could lead to an erosion of public trust. Moreover, Chen et al. (2023) emphasize that ethical issues such as transparency, accountability, and the alignment of AI technologies with public values are central to public sector AI adoption. The potential for AI to operate in ways that challenge societal norms, without sufficient safeguards, contributes to a significant public distrust. Chen et al. (2023) add that "The broad societal impacts of AI systems have created the need for ethical considerations beyond service-focused public values. The development of machine ethics and a framework for impact assessment is an effort to assist with the governance of AI systems" (Chen et al., 2023, p. 3).

Another pressing environmental barrier is the digital divide, which is discussed by Millan-Vargas et al. (2024). The digital divide exacerbates inequality in access to technology, which can prevent certain demographic groups from benefiting equally from AI-powered public services. This divide is especially relevant in the public sector, where the reliance on technology must be accompanied by equitable access to digital infrastructure. Millan-Vargas et al. (2024) also mention cybersecurity concerns as a growing barrier, noting that the increased risk of cyberattacks and data breaches related to AI applications in government services further complicates the adoption of AI.

On the other hand, supportive policy and regulatory environment are enablers for AI adoption. A well-established regulatory framework not only ensures the ethical deployment of AI but also provides a foundation for AI-driven public services to thrive. Mikalef et al. (2021) highlight that regulatory support significantly impacts municipalities' decisions to adopt digital solutions, including AI, especially when aligned with strategic digital goals. Fetais et al. (2022) stress that strong leadership and management support are also crucial, as top management can allocate the necessary resources and adjust organizational structures to facilitate the adoption of AI technologies.

Further enabler factors include digital infrastructure investment. Tomaževič et al. (2024) emphasize that a mature digital infrastructure, including high-bandwidth internet and sufficient processing power, is vital for the successful deployment of AI technologies. Such infrastructure enables the complex data processes and computational requirements inherent in AI systems, making it a key enabler for governments already invested in e-government services. The availability of robust digital infrastructure allows public institutions to build on their existing IT capabilities, enabling a smoother transition to AI-powered services (Tomaževič et al., 2024).

Tangi et al. (2023) underscore the importance of managing organizational change when adopting AI, particularly in the deployment phase. As AI is integrated into public sector processes, organizations may face challenges in adjusting their internal structures and processes to accommodate these new technologies. They highlight that these challenges differ significantly between the piloting and deployment phases, requiring distinct strategies and approaches at each stage. Tangi et al. (2023) propose that a fifth class of challenges, AI organizational and cultural change, deserves more attention, emphasizing the need for dynamic and innovative organizations capable of integrating AI into daily operations (Tangi et al., 2023, p. 421).

3.12 Summary of Key Findings and Gaps

The literature on AI adoption in e-government highlights several barriers and enablers across three key areas: technological, organizational, and environmental.

Technological barriers primarily involve data quality and interoperability issues. Inaccurate, fragmented, or siloed data hinders AI effectiveness (Wirtz et al., 2019), and insufficient infrastructure further complicates implementation (Mikalef et al., 2021; Millan-Vargas et al., 2024). However, strong IT infrastructure is frequently cited as an essential enabler for successful AI adoption (Tomaževič et al., 2024; Fetais et al., 2022).

Organizational barriers include skills gaps and resistance to change. Public sector organizations often lack the technical expertise necessary for AI deployment (Noordt et al., 2023), but leadership support and organizational readiness are critical enablers that help overcome resistance (Tomaževič et al., 2024; Fetais et al., 2022).

Environmental barriers involve regulatory uncertainty, ethical concerns, and public distrust. Issues such as privacy legislation and procurement regulations can hinder AI adoption (van Noordt & Misuraca, 2022), while concerns over ethics and trust in AI governance are critical (Chen et al., 2023). On the other hand, a supportive regulatory environment is identified as an important enabler (Mikalef et al., 2021; van Noordt et al., 2025).

Despite the documentation of these barriers and enablers, gaps remain, particularly regarding the integration of AI within public sector organizations and the cultural changes necessary for scaling AI solutions. There is also insufficient understanding of how funding strategies are articulated and implemented in practice (van Noordt et al., 2025). These gaps form the rationale for this study, which will focus on a case study of BüroKratt in Estonia. Using semi-structured interviews with BüroKratt stakeholders, the

study will explore how these barriers and enablers manifest in practice, guided by DOI, TOE, Stakeholder Theory, and Institutional Theory.

4 Methodology

4.1 Research Design

This study employs a qualitative case study approach to explore the barriers and enablers of implementing AI-enabled e-government services, focusing on the BüroKratt initiative in Estonia. A qualitative approach is ideal for understanding complex, context-specific phenomena like AI adoption, as it provides in-depth insights into technological, organizational, and societal factors (Creswell & Poth, 2018).

The case study design (Yin, 2018) is particularly suitable for examining a real-life instance of AI implementation in a public sector setting, allowing for a detailed investigation of the challenges and opportunities in this context. Case studies are valuable for understanding the dynamics between technology, stakeholders, and organizational culture, especially when the boundaries between the phenomenon and context are not clearly defined (Yin, 2018).

By focusing on the BüroKratt case, this research can uncover both general and unique barriers and enablers, while also comparing these findings to the broader literature on AI in public sector services.

4.2 Case Study: BüroKratt

BüroKratt is an ideal case study for exploring AI-enabled e-government services because it represents one of the first large-scale implementation attempts of AI in the Estonian public sector. It was part of Estonia’s national digital strategy, and it serves as a significant example of how AI could enhance public sector efficiency and service delivery.The National AI Strategy (Ministry of Economic Affairs and Communications, 2021) highlighted the importance of KrattAI, which powers BüroKratt, as a key initiative in Estonia’s AI strategy which aimed to transform government services. The strategic importance of BüroKratt is further emphasized by its role as a national AI assistant, contributing to the country's reputation as a leader in digital governance (European Commission, n.d.; Kratid, n.d.).

BüroKratt’s integration as a cloud-based service, made available through the State Information System (Riigi Infosüsteemi Amet, n.d.), exemplifies how AI can be leveraged to automate and enhance interactions between citizens and government agencies. Its technical architecture, as detailed in the GitLab high-level architecture document (Turner, 2021), provides a comprehensive view of the infrastructure supporting a modular platform.

Estonia is renowned for its leadership in digital governance, a distinction made possible by continuous investment in digital infrastructure and e-government initiatives. BüroKratt plays a central role in this innovation, as evidenced by its alignment with the country's Digital Agenda 2030 (Ministry of Economic Affairs and Communications, 2022). As part of this agenda, BüroKratt contributes to the broader vision of integrating AI across all levels of government service delivery.

The platform's implementation is also deeply tied to Estonia's Recovery and Resilience Plan, which outlines strategic investments in AI and digital technologies to enhance public services and drive economic recovery (Niestadt, 2023). These documents underscore the pivotal role of BüroKratt in facilitating more efficient government services and promoting a digital transformation that other countries might look to replicate.

4.3 Data Collection

Following the approach outlined by Braun and Clarke (2006), this research employs thematic analysis to examine the interview data collected. Thematic analysis is selected because of its flexibility and suitability for identifying, analyzing, and reporting patterns (themes) in qualitative data.

The coding strategy employed is deductive coding. The initial codes are derived from the following theories: DOI, TOE, Institutional, and Stakeholder. These theories inform the development of a codebook that categorizes data related to technological, environmental, institutional, and stakeholder related enablers and barriers.

The analysis follows a two-stage coding process. In the first stage, the TOE framework is employed to code the data. This enables a structured comparison with the literature review. Based on thematic prominence and relevance, the top three enablers and barriers are identified for each TOE dimension. In the second stage, the data is re-coded using all four theories. Through this approach, the top five cross-cutting enablers and barriers are identified. This approach is utilized in order to allow a more holistic understanding of the factors that influence AI implementation in e-services.

The coding process is conducted manually, using a structured Excel spreadsheet. Each transcript is read multiple times to ensure familiarity with the data. Segments of text are categorized under relevant theory dimensions. It also allows for sub-themes to be noted within each category. Manual analysis is chosen as the size of the dataset is manageable. It also allows an iterative refinement of codes.

In order to allow theoretical anchoring, theoretical triangulation is applied. Emergent themes from the interview data are cross-referenced with the enablers and barriers identified in the literature review in section 3.9-11. This enables a comparison which strengthens the interpretive rigor of the research.

5 Results

5.1 Introduction

This chapter presents the key findings from the qualitative analysis of eight interviews with stakeholders representing a range of roles across Estonian public sector and partner organizations. These interview participants were selected based on their involvement in, proximity to, or expertise related to the visioning, design, development, implementation, or governance of BüroKratt. As well as, broader AI policy and digital innovation in the public sector.

As outlined in the methodology, the analysis is conducted in two stages. In the first stage, the TOE framework is applied to identify the top three enablers and barriers within each dimension. In the second stage, a broader theoretical lens is used, incorporating DOI, Institutional Theory, and Stakeholder Theory. This is done to identify the top five cross-cutting emerging enablers and barriers of implementing an AI enabled e-service.

Subsequently, each section begins with illustrative quotes from participants which are followed by a summary table of the identified themes. Table 1 below provides an overview of interview participants.

Table 1.Interview Participants.

Interview ID	Participant Title
INT001	Former Government Chief Technology Officer
INT002	Services Project Manager of Bürokratt
INT003	Leading the Bürokratt Development Team
INT004	Product Owner of Bürokratt
INT005	IT Architect of Bürokratt
INT006	Data Policy Advisor
INT007	PhD Digital Transformation & AI in Public Services
INT008	PhD E-Governance

5.2 TOE Framework: Enablers and Barriers

This section presents the top three enablers and barriers within each dimension of TOE Framework, as identified through the thematic analysis of the interview data. Illustrative quotes are used for each domain to support the findings and is followed by a summary table

5.3 Technological Context Enablers

Within the technological domain, several participants discussed both architectural and infrastructure related aspects that underpinned the development of Bürokratt. One commonly referenced enabler is the decision to make Bürokratt open source. This was seen as a strategy that promotes transparency, avoids vendor-lock, and is a means to foster wider adoption.

"Everything is in the public GitHub. Absolutely everything from draft ideas to fine-tuned code." INT005
"We have made security tests on the software and all the development that we do is actually public, so it's open source software. Any kind of other country or private sector company who wants to use the same chatbot can actually use the code and start using it as well." INT003

Another enabler mentioned by participants is the system's modular design. This architecture allows the reuse of components, simplifies updates, and supports scalability.

"BüStakk contains five key components where they are making development of new services…we don't write any Bürokratt specific code…everything is just DSL or domain specific language…they're YAML files where business logic is described…it means that you can have business logic just how to connect with some database or LLM…everything is configuration file based." INT005

"We eliminated them with this limitation of being monolith to a more modular and easy to update solution, whether we have 10 clients or 100 clients in the future." INT003

Participants also highlighted interoperability as an enabling factor. BüroKratt connects with Estonia's national infrastructure, which includes the national cloud and the X-Road data exchange platform.

"We are working closely together with the national cloud system nowadays. (INT004)

"It means when intent is detected, it makes a request to some X-Road endpoint, and if you get something from [X-Road] send it, process it." (INT005)

5.4 Technological Context Barriers

While the technological environment was viewed as supportive, participants identified several barriers. One issue that was raised was the burden associated with chatbot training. Initial assumptions about organizational readiness and willingness to train the model did not always match reality.

"Chat bots in general, while not bad, they were really difficult to train to not make mistakes. Everybody was making fun of these chatbots." INT001

"The hypothesis was that organizations are themselves very interested in training the chatbot, but the hypothesis was very wrong... they have to invest a lot of people's hours to make it work." INT003

Another challenge was the availability and quality of data required to train the chatbot. Participants described the difficulties that arise when there are insufficient training examples for specific intents.

"If there are not enough examples for question and answer, then this model is actually not very useful." INT003

"We didn't have enough examples to understand the intents." INT002

Finally, several participants described the limited effectiveness of NLP/LLM to accurately process Estonian language. This impacted the system's ability to handle user inputs and restricted the integration of more advanced language based features.

"We are not live on the LLM part, because one year ago, the LLM did not speak well enough Estonian language so it wasn't usable." INT003

"On the implementation side, it's very hard, although it's gotten better the past couple years, but just the Estonian language being not as highly spoken, and I think you're seeing this all over the world with smaller countries more, they do have the threat of being kind of left behind in this new AI world." INT008

5.5 Organizational Context Enablers

Within the organizational domain, participants discussed both structural and procedural aspects that either supported, or constrained the development and deployment of BüroKratt. One common enabler described by participants is top management support. Strategic leadership from senior government figures helped launch and maintain momentum for the BüroKratt initiative.

"There was Chief Data Officer…he is one of those people who is adept at changing his style and strategy based on what was necessary at the time." INT007

"I was involved with designing the Estonian digital agenda 2030, was one of the core authors of it, which included the AI and BüroKratt initiative.I worked closely in collaboration with both the implementation team as well as the team with the

government, the Chief Data Officer who was directly responsible for the implementation." INT001

Another organizational enabler mentioned is agile procurement practices. This allowed the team to collaborate with multiple vendors bound by time, and scope.

"We decided to have as many development partners as possible. We ended up with 28 registered partners. We do scoped procurement…developments last three months maximum." INT005

"[Outside developers] I would say that we have a solid team who's working with us." INT004

Knowledge sharing across organizations is also identified as an important enabler. Participants explained how onboarding packages and shared expertise helped their clients and other ministries.

"[When onboarding a Ministry]As a welcome package for every model, it already consisted of these intents and examples of topics that are overarching." INT002

"In terms of language technology, what the capabilities are, we are quite good at providing this experience or expertise to other organizations in the public sector as well." INT003

5.6 Organizational Context Barriers

Several barriers were also identified. A key referenced issue is human resource limitations. Small team sizes and competing priorities affected delivery timelines and workload distribution.

"You know it's a small team and yeah, I think it's pretty replicable along a lot of smaller countries, but it's just like the human capital is, the talent is high, but the resources are very low… So I think it does come down to you know the not, there's just not a lot of people." INT008

"It was such a small team [BüroKratt Team]...they already have so much on their plate and they're understaffed." INT007

Procurement misalignment was a barrier that was also mentioned several times. Participants described outsourcing issues which hindered progress of projects.

"The body leasing part, you have to get very good experts who can actually help developing, and there have been previously very bad examples where they win a tender, the government board, and then they actually cannot provide any value for the development and then you have to, because of the bureaucracy, you cannot just eliminate or even if you eliminate this provider, then it takes another three months to get the next developer on board." INT003

"My expectation was that there will be a lot of interest from small companies [but] Estonian companies didn't go for it." INT005

Finally, institutional drift was noted by participants as a subtle but important issue. The relocation of digital governance responsibilities, and shifting internal priorities created distance from original aims and objectives.

"We have shifted from E-services to LLM…it's been gradual daily basis, what we have on our backlog for the next week or two, and for some reason, user interface and LLMs have had the most power business side." INT005

[BüroKratt] it was moved to Justice Ministry…that of course creates its own governance issues and adjustment issues…most governments have consulted if they have digital issues under justice, then they are struggling." INT001

5.7 Environmental Context Enablers

Participants identified several environmental factors that enabled the development and implementation of BüroKratt. One of the common enablers mentioned was public sector funding which included funding provided by the ministries, and the European Union. This funding enabled the initiation and development of the initiative.

"The goal set for us by the Ministry of Economic Affairs. Who funded this project, or funds this project, with EU money." INT005

"We as a ministry, we like gave the money to the organization [to pilot AI initiative], but the organization later, for this project is going to have their own finances." INT006

Another enabler was Estonia's digital culture, and its broader commitment to technological leadership. Participants noted that Estonian organizations are generally receptive to innovation, and that the country's ambition to remain a digital pioneer supports new technology adoption.

"In general, Estonia being like this digital society, and wanting to maintain this digital leadership, organizations usually are not against technical topics and using digital technologies." INT006

"To be like a market leader in technology as a small country which allows them to punch above their weight class in technology.So I think that coinciding with the hype cycle of of AI made them want to get on that…Estonia was one of the first early countries who made like a national AI policy you know early." INT007

Finally, some participants discussed external benchmarking. Participants described the importance of learning from other countries and sharing experiences at international events. This allowed them to gauge progress and adopt global best practices.

"I think we were very much paying attention also to what other countries are doing. Sort of seeing what the UK is doing; the UK is very, very successful in various digital

initiatives. Seeing what Singapore is doing and then hearing things, you know what Canada is trying out or attending this conference where these things are discussed. So definitely being inspired by what others are doing also made us want to do new things and sort of get our message out there as well." INT001

"We have spoken with a lot of other governments who are still in the beginning phase of thinking about such chat bots on a government level, and we always see how they are impressed with the thing we have today." INT003

5.8 Environmental Context Barriers

While participants highlighted several enabling environmental conditions, they also noted contextual factors that posed barriers. A key barrier mentioned by several participants was market pressure, particularly following the widespread public adoption of tools like ChatGPT. Participants described a growing expectation of BüroKratt to perform at the same level regardless of constraints.

"They're comparing us a lot to ChatGPT saying, oh, this is answering every question, but they don't really know if it's correct or not." INT004

"Once ChatGPT became a thing, it essentially exploded to market. Everybody was seeing that ChatGPT can do these things that are very difficult for you to implement in BüroKratt, and it created this strain." INT001

Another barrier discussed was risk aversion. They noted that the potential for harm from incorrect AI-driven decisions created caution around deployment.

"The main pressure is just [the] risk to make something, some like mistake. You know, about different bad cases of not proper AI use in other countries…decisions were wrongfully made about many people, and there were…many people who suffered from that. So definitely…you don't want to make something like that happen in Estonia." INT006

"One of the issues that is often the case with AI, is that people are saying that, but AI is wrong, sometimes it's incorrect as if forgetting that people aren't. I think one of the key issues where people sometimes don't want to implement AI, they believe that if I'm removing human from this process, suddenly I'm more flawed." INT001

Finally, some participants discussed regulatory uncertainty, or regulatory burden.

"There are, of course, privacy and security issues because everything we can make the model do is on public data. So we cannot train on something that is more, let's say private." INT003

"In light of the AI Act, that also can now raise more questions [for] organizations. If they develop one solution, is it compliant with AI Act? What additional things we need to do to make sure that everything is compliant?" INT006

Table 2 below provides an overview of barriers and enablers that were identified by domain.

Table 2. Enablers and Barriers by TOE Domain.

TOE Domain	Enabler	Barrier
Technological	Open-Source Architecture	Manual Training Burden
	Modular Architecture	Data Quality/Availability
	Interoperability	NLP/LLM Language Limitation
Organizational	Tope Management Support	HR Constraints
	Agile Procurement	Procurement Misalignment
	Knowledge Sharing	Institutional Drift
Environmental	Environmental Funding	Market Pressure
	Culture	Regulatory
	External Benchmarking	Risk Aversion

5.9 Cross-Theory Analysis of Enablers and Barriers

This section presents the second stage of the analysis. In this stage the data is re-coded using broader theoretical lenses. The theories employed are: DOI, Institutional, Stakeholder, and TOE framework. This serves the purpose to identify cross-cutting enablers and barriers. These themes reflect broader factors that influence the implementation of AI enabled e-services beyond the structural categories afforded by the TOE framework.

5.10 Enablers

Stakeholder Engagement
Participants highlighted the importance of proactive and regular engagement with stakeholders in the design and development of BüroKratt.

"We definitely as a team, [our] direct stakeholders we had I think bi-weekly seminars where we gave an overview of what's done, where are the problems that they were having, how are they being solved, when are they being solved." INT002

"We have very good support from Microsoft, even if we haven't made a contract, they are simply advising us for half a year already in a very technological manner." INT003

Innovation Vision
The long-term ambition to modernize public service delivery was noted as a motivating factor for the initiative.

"*I published a white paper that was discussing the next generation digital government architecture, which included AI driven ecosystems…the traditional way of providing government services is outdated in principle and that the future of government services are going to be provided through conversational manner.*" INT001

"*Ambition was very, very big before even the world of LLM started in 2023 and I think the implement, like the idea of* BüroKratt *was that it would solve any kind of issues a citizen might have." INT003*

Innovation Drivers
Participants emphasized cultural and procedural expectations that created pressure to innovate.

"*There is a requirement in Estonia, when a citizen contacts, for example, writes an e-mail to one agency, the agency definitely has to respond.That was one of the key issues that* BüroKratt *was supposed to solve.*" INT002

"*Estonia has this inner need to be innovative and advanced in our digital efforts*." INT001

Technology Vision
Participants described a strong technical vision underpinning the system, particularly around modularity and open-source use.

"We wanted to be modular, so today as a result of this, we can have all of our clients use one LLM, three LLM, seven, they can just decide what they want. It is just a matter of changing an endpoint in these configuration files or DSLs." INT005

"Whatever kind of requirements the clients [Ministries who have adopted BüroKratt] are putting to us, we always look at what is open source so that it would be no additional cost and no interlock." INT003

Inter-Agency Collaboration
Collaboration across ministries and public agencies was identified as an enabler.

"What is great about the public sector in Estonia and what is especially in the fields of AI and data, we have quite big community consisting of people from different

agencies." INT006

"We actually worked very well together as a team.
We didn't really see the lines, the arbitrary lines between like, you are from RIA, you are from MKM." INT002

5.11 Barriers

Innovation Disruptor
Participants described how the rapid emergence of commercial chatbots like ChatGPT disrupted existing development strategies.

"The quick speedy evolution of chatbot functionalities, kind of completely obliterated the development strategy of BüroKratt." INT008

"So BüroKratt wise, I think the problem that was made was that language technology got less attention right after ChatGPT came out, and on some level people think we have ChatGPT, why do we have to do anything on our own?" INT005

Technology Constraints
Challenges were noted with the maturity of some open-source components, as well as the components needed for Estonian language support among others.

"Everything is built upon open source software elements, so the maturity of these software elements that we need, is sometimes not met in that time." INT003

"[Estonian Language] at that time, at least, it wasn't a very common language.So we had to collect our own language corpora, meaning language data on Estonia." INT002

Resource Constraints
Participants described ongoing issues with personnel and organizational capacity.

"But if we are team of 10 in public sector office and out of these 10, at least half of them are like high level business persons and some are technical and maybe one is doing language technology then it's not, it doesn't make sense to expect better results when you get from, let's say, Meta, or Microsoft." INT005

"The main issue has been that the core governance team of digital sort of central government CIO team hasn't been in place for over a year… and we have had trouble hiring a new one." INT001

Institutional Resistance
Several participants observed that ministries and decision-makers sometimes diverged from agreed strategic visions or misunderstood technical needs.

"Even though we got the digital Agenda 2030 approved by the Parliament, which was a high level strategic document that's driving all this vision, then still ministries have their own agendas." INT001

"[Decision Makers] I'd say that the biggest problem has been, at some point, lack of understanding. I said we shouldn't focus on natural language development, but probably as a result, it seems to decision makers that we don't need language technologists. That's not correct because if we outsource some part of our solutions, LLMs and classifiers, it means that we have to have a VERY highly skilled specialist who knows how to ask the right questions." INT005

Innovation Resistance
Finally, some resistance to change at the organizational level was noted.

"There might be some people who are used to doing things, and maybe it's sometimes hard to switch to another way." INT006

"But, there you have to understand that every authority in the institution is totally different depending on the leadership and so on. Some are more open to try new things. Some are, everything is working fine, we don't want to try new things." INT004

Table 3 below provides a summary of the cross-theoretical enablers and by theme and theoretical anchors.

Table 3.Summary of Cross-Theoretical Enablers and Barriers.

Type	Theme	Theoretical Anchor(s)
Enabler	Stakeholder Engagement	Stakeholder
	Technology Vision	TOE, DOI
	Innovation Vision	DOI, Institutional
	Inter-Agency Collaboration	Stakeholder, Institutional
	Innovation Drivers	Institutional, TOE
Barrier	Innovation Disruptor	DOI, Institutional
	Technology Constraints	TOE, Stakeholder
	Resource Constraints	Institutional, TOE
	Institutional Resistance	Institutional
	Innovation Resistance	Institutional, Stakeholder

6 Discussion

6.1 Introduction

This chapter interprets the empirical findings presented in Chapter 5 through the lens of the theoretical frameworks and the existing literature discussion in chapters 2 and 3. The purpose of this chapter is to answer the first research question: What are the barriers and enablers to implementing AI-enabled e-government services, and how do the findings from the BüroKratt case compare with those identified in the existing literature?

The discussion is structured in two parts. The first part is organized using the TOE framework and compares the top three enablers and barriers identified within each domain: technology, organization, and environment, to the factors found in the literature review. The second part broadens the analysis to include a cross-theoretical lens. Here, the findings are revisited using elements from DOI, Institutional Theory, and Stakeholder Theory to explore overarching patterns and cross-cutting influences.

Estonia provides a unique national context for this discussion. As a global leader in digital government, the country's strong infrastructure, innovation culture, and long-standing investment in e-governance create a supportive environment for initiatives such as BüroKratt. At the same time, the case also reveals practical constraints that persist even in digitally advanced settings. By grounding the discussion in the Estonian experience, the chapter offers insights that may be relevant to both frontrunner and emerging digital governments.

6.2 Comparison of Findings Using TOE Framework

6.2.1 Technological Context

Enablers

Several of the technological enablers identified in the case study align closely with those noted in the literature. The modular architecture of BüroKratt was viewed by participants as a key strength. This allowed different agencies to configure the system according to their needs and enabled scalability. These findings are consistent with Dreyling III et al. (2024), who highlight modular and cloud-based infrastructure as critical enablers for AI adoption, especially when multiple actors are involved.

The use of open-source software was also viewed as a major enabler, reducing vendor lock-in, and increasing transparency. This supports the argument made by Fetais et al. (2022), who emphasize that open, flexible architectures can ease adoption and foster cross-sector innovation. Moreover, interoperability with national platforms such as the X-Road, and Estonia's government cloud was described as essential. This aligns with Sivarajah et al. (2016), who underline that interoperability is a prerequisite for integrated and intelligent service delivery.

Barriers

On the other hand, participants also described a number of technological barriers. One commonly referenced challenge was the limited availability and quality of training data. This reflects concerns raised by Wirtz et al. (2019), who argue that data quality and volume are foundational for any AI system. When examples are lacking, the effectiveness of machine learning models declines significantly.

Another barrier was the burden of manually training the chatbot. Contrary to early assumptions, organizations were not always equipped or willing to take on this responsibility. While Sivarajah et al. (2016) focus on broader data challenges such as interoperability and silos, their work highlights the kinds of systemic issues that can contribute to operational burdens like AI training.

Finally, several participants noted the difficulty of building NLP tools for the Estonian language. While the literature does mention language processing as a sub-theme, this case study draws attention to the challenges faced by small-language countries. It may be indicative of a barrier for countries that do not have a widely spoken language, and as such, may face similar constraints.

6.2.2 Organizational Context

Enablers

Top management support was described by participants as a key factor enabling the launch and continuity of the BüroKratt initiative. Leadership from senior government figures, particularly the Chief Data Officer, was viewed as instrumental in aligning strategic priorities. This supports the findings of Fetais et al. (2022), who highlight top management support as a primary enabler of AI adoption in the public sector.

Agile procurement practices were also identified as a structural enabler. Participants described the use of scoped procurement models and short development cycles that supported collaboration with external partners. This partially contrasts with van Noordt et al. (2022), who describe traditional procurement as a constraint. In the case of BüroKratt, procurement was adapted to meet the needs of fast-moving technology projects, suggesting a more flexible approach than typically documented in the literature.

Knowledge sharing across government entities was seen as another enabling factor. Participants described how onboarding materials and technical guidance helped support adoption by other ministries. While this theme receives limited attention in the reviewed literature, it complements the work of Tomaževič et al. (2024), who argue that intra-organizational collaboration is essential for scaling AI initiatives.

Barriers

Human resource limitations were commonly mentioned. Small team sizes and limited technical capacity affected the project's ability to manage workloads and maintain

progress. This aligns with van Noordt et al. (2022), who identify technical skills shortages as a recurring barrier across public sector AI projects in Europe. It also reflects Tomaževič et al.'s (2024) point that resource constraints can undermine even high-priority digital initiatives.

Procurement misalignment was raised as a barrier when standard outsourcing processes resulted in poor quality deliverables, or project delays. While agile procurement was an enabler for onboarding outside talent, participants described instances where bureaucratic rules prevented the removal of underperforming vendors. This is consistent with van Noordt et al. (2022), who argue that procurement frameworks are often incompatible with the iterative and experimental nature of AI projects.

Institutional drift was also discussed by participants. This refers to shifts in responsibility, strategic focus, or organizational alignment that gradually moved the initiative away from its original goals. While this theme is less frequently discussed in the AI adoption literature, it reflects broader insights from Institutional Theory, which suggest that evolving internal dynamics and governance changes can significantly affect long-term project direction (Selten & Klievink, 2023).

6.3 Environmental Context

Enablers
Participants highlighted the importance of public sector funding, particularly from the Ministry of Economic Affairs and the European Union. This financial support enabled the initial development and piloting of BüroKratt. These findings align with Mikalef et al. (2021), who emphasize the enabling role of aligned funding strategies in public sector innovation. Similarly, van Noordt et al. (2025) identify funding clarity as essential for AI initiatives to move beyond pilot phases.

Estonia's digital culture was another commonly referenced enabler. Participants noted that the country's strong digital identity and innovation mindset created a favorable environment for adopting AI technologies. This supports the findings of Hjaltalin and Sigurdarson (2024), who describe national innovation cultures as critical to fostering AI readiness. It also echoes institutional perspectives that highlight the role of normative pressures in shaping technology adoption (DiMaggio & Powell, 1983).

Finally, external benchmarking was described as a motivator. Participants reported drawing inspiration from other countries' digital government strategies. This mirrors the mimetic pressures discussed in Institutional Theory and aligns with Fetais et al. (2022), who highlight international learning and benchmarking as enablers of AI diffusion in public sector settings.

Barriers
Market pressure was noted by several participants as a barrier that emerged following the widespread adoption of commercial tools such as ChatGPT. Participants described how user expectations began to shift, placing increased pressure on BüroKratt to deliver similar results. This challenge is not widely reflected in the literature reviewed, but may represent an emerging issue for e-government AI enabled services operating alongside rapidly evolving e-government tools.

Risk aversion was another barrier discussed. Participants expressed concern about potential negative consequences of AI errors, particularly in high-stakes public sector settings. This finding supports the work of Chen et al. (2023), who emphasize that perceived risk and ethical concerns can reduce institutional willingness to experiment with AI.

Finally, regulatory complexity was described as a constraint. Participants noted uncertainty around compliance with the EU AI Act and limitations related to data privacy. These issues closely align with the concerns raised by van Noordt & Misuraca (2022), who identify regulatory uncertainty as one of the most persistent barriers to AI adoption in the public sector.

The findings from the BüroKratt case show broad alignment with the literature on AI implementation in e-government. Across all three TOE domains, many of the barriers and enablers identified in the literature were reflected in the empirical data. At the same time, the case highlights additional themes such as institutional drift, small-language limitations, and market pressure from commercial AI tools, factors that are less developed in the current literature. These Estonia-specific insights add nuance to existing frameworks and suggest areas where future research may be needed.

Table 4 below provides a comparison of TOE enablers and barriers identified in the BüroKratt case with existing literature.

Table 4. Toe BüroKratt Barriers and Enablers vs. Literature

TOE Domain	BüroKratt	Literature Alignment
Technology Enablers	Modular Architecture, Open-Source, Interoperability	Dreyling III et al. (2024), Fetais et al. (2022), Sivarajah et al. (2016)
Technology Barriers	Training Burden, Data Availability/Quality, NLP/LLM Language Limitations	Wirtz et al. (2019), Tomaževič et al. (2024)
Organization Enablers	Top Management Support, Agile Procurement, Knowledge Sharing	Fetais et al. (2022), Tomaževič et al. (2024)
Organization Barriers	HR Constraints, Procurement Misalignment, Institutional Drift	van Noordt et al. (2022), Selten & Klievink (2023)

TOE Domain	BüroKratt	Literature Alignment
Environmental Enablers	EU/Ministry Funding, Innovation Culture, Benchmarking	Mikalef et al. (2021), Hjaltalin & Sigurdarson (2024), Fetais et al. (2022)
Environmental Barriers	Market Pressure, Risk Aversion, Regulatory Uncertainty	Chen et al. (2023), van Noordt & Misuraca (2022)

6.4 Cross-Theoretical Discussion

The second stage of analysis employed multiple theoretical lenses to capture a more holistic view of the enablers and barriers influencing AI implementation in e-government services. While the TOE framework provided a structured categorization, applying DOI, Institutional Theory, and Stakeholder Theory revealed broader dynamics that shaped the BüroKratt initiative.

Enablers Across Theoretical Lenses

Stakeholder engagement emerged as a key cross-cutting enabler. The inclusion of both internal and external actors in regular consultations and workshops supported alignment and issue resolution. This finding aligns with Stakeholder Theory, which emphasizes that inclusive collaboration increases the legitimacy and responsiveness of digital government initiatives (Bryson et al., 2015).

Similarly, a shared technology vision played a foundational role. The emphasis on open-source and modularity demonstrates high levels of perceived compatibility and relative advantage, two core concepts in DOI (Rogers, 2003). This technical strategy not only aligned with Estonia's digital infrastructure but also reinforced stakeholder trust and adaptability.

The analysis also revealed strong institutional enablers, particularly cultural and normative pressures to innovate. Estonia's digital identity and its ambition to remain a global leader in e-government created an institutional environment that was generally receptive to experimentation. These findings reflect the influence of normative isomorphism, as discussed by DiMaggio and Powell (1983), where shared professional values support policy convergence.

Barriers across Theoretical Lenses

Despite these strengths, several cross-cutting barriers were identified. One recurring theme was resource constraint, the small team sizes, limited language technology expertise, and delayed leadership appointments were repeatedly referenced. While this aligns with organizational capacity issues under the TOE framework, it also reflects

institutional gaps in sustaining digital governance structures. As van Noordt et al. (2022) suggest, capability and leadership deficits remain widespread even in digitally advanced contexts.

Another significant barrier was institutional resistance. Although strategic visions were in place, several participants described how ministries interpreted or implemented these visions differently. In some cases, this led to misalignment or neglect of key technical needs, such as language technology expertise. This divergence supports the idea that institutional drift or fragmentation can undermine national digital strategies, even when high-level policy support exists.

Finally, the emergence of commercial AI tools, particularly ChatGPT, disrupted internal development processes. The speed and visibility of market-led innovation created both performance pressures and public comparisons. This phenomenon reflects an overlooked aspect of DOI where innovations external to an organization can shape internal adoption trajectories by reframing expectations or shifting perceived value.

6.5 Synthesis and Implications

This section synthesizes the findings from both stages of analysis and proposes practical strategies to address the identified barriers. It draws together insights from the TOE framework and cross-theoretical analysis, linking them to the broader literature reviewed in Chapter 3. The aim is to develop actionable implications that inform the implementation of other AI-enabled e-government services, particularly in digitally mature contexts like Estonia.

The synthesis reveals that successful AI implementation in e-government services is not solely dependent on technical infrastructure or strategic ambition. Instead, it is shaped by the interaction between technological capacity, organizational readiness, institutional alignment, and stakeholder dynamics. The case of BüroKratt demonstrates that while Estonia possesses strong digital foundations, this does not automatically guarantee a seamless integration of emerging technologies such as AI. In fact, the findings suggest that political or strategic ambition, while essential for initiating innovation, can at times create expectations that are not grounded in current technological realities. When ambitions outpace the maturity of the tools available, such as in the case of early NLP limitations, or vendor readiness, delivery teams may face unrealistic demands that strain resources and compromise focus.

One key pattern is the dual role of stakeholder engagement. While inclusive collaboration between the core development team and ministries served as an enabler, it also contributed to institutional drift. As ministries shaped the direction of development based on their immediate needs, this gradually pulled the project away from its original long-term vision. Similarly, agile procurement supported rapid development cycles but was undermined by inconsistent vendor performance and rigid replacement procedures. These insights reinforce the findings of van Noordt et al. (2025) who stress that implementation is often hindered not by lack of strategy, but by operational misalignment.

Another insight is the importance of adaptability. The emergence of ChatGPT introduced disruption but also prompted necessary shifts. The transition from Rasa NLP

to LLMs, combined with local partnerships to improve Estonian language corpora, helped address earlier training challenges. This suggests that adaptive capacity, defined by the ability to pivot in response to technological changes, should be considered a key success factor in AI implementation.

It was also noted that a recent institutional change, the transfer of responsibility for AI initiatives from the Ministry of Economic and Communication Affairs to the Ministry of Justice and Digital Services raises open questions about the future direction and coordination of AI-enabled public services. While the long-term implications remain uncertain, such shifts may affect the governance and ownership structures critical for sustained innovation.

From a theoretical standpoint, this case highlights the limitations of treating enablers and barriers as fixed. Many of the identified factors were contingent, initially enabling, but later becoming constraints. This aligns with Hjaltalin and Sigurdarson's (2024) observation that digital transformation requires continual realignment between technology, policy, and institutional structures.

6.6 Proposed Strategies for Other AI Initiatives in E-Government

Drawing on the findings from the BüroKratt case, this section outlines a set of practical strategies that can support the implementation of other AI enabled e-government services.

Ensure In-House Expertise for Outsourced Procurement

Outsourcing enabled development but led to issues with vendor performance. Having internal experts involved in oversight and validation ensures that deliverables meet technical and strategic requirements.

"We have to have a VERY highly skilled specialist who knows how to ask the right questions." INT005

Strategy**:** Employ or assign in-house AI experts who can evaluate the quality and appropriateness of outsourced solutions throughout the development lifecycle.

Balance Political Vision with Technological Readiness

While ambition drove initial momentum, it sometimes outpaced what was technically feasible, especially with NLP maturity and resource constraints.

"The other thing I would say is it's really easy to write a giant vision paper, and it's hard to execute on vision paper and sometimes, you should do more research before you publish a vision paper." INT007

Strategy: Align AI policy ambitions with practical assessments of current infrastructure and skill readiness to ensure that expectations remain actionable.

Strengthen Continuity in Digital Governance Structures

Leadership transitions and institutional drift affected alignment across ministries.

"We have had trouble hiring a new [central CIO]." INT001

Strategy: Align AI policy ambitions with practical assessments of current infrastructure and skill readiness to ensure that expectations remain actionable.

Codify Stakeholder Engagement to Avoid Vision Drift

While stakeholder engagement was strong, it sometimes pulled the initiative away from its original goals due to ministry (BüroKratt's client) priorities.

"It's been gradual…user interface and LLMs have had the most power business side." INT005

Strategy: Clearly define the scope of stakeholder influence during implementation and preserve the integrity of the original strategic vision through anchored governance structures.

Embed Regulatory Foresight into Design Processes

Concerns around compliance with EU AI Act, GDPR, and ethical standards created uncertainty for implementing agencies. As raised by Interviewee 6, ensuring that AI solutions are transparent, ethical, and human-centric requires proactive planning and cross-ministerial coordination.

"I'm leading some projects…making solutions more transparent and also making sure that the solutions we use, organizations have a knowledge how it is better to ethically implement AI solutions." INT006

Strategy: Involve legal, ethical, and policy advisors early in the development lifecycle. Embedding foresight mechanisms, including regulatory impact assessments and ethical audits, can help mitigate compliance risks and foster public trust in AI services.

7 Summary

7.1 Summary of Key Findings

This study explored the barriers and enablers to implementing AI-enabled e-government services through the case of BüroKratt in Estonia. Using the TOE framework and broader theoretical lenses (DOI, Institutional, Stakeholder), the findings show that successful AI adoption is shaped by more than just technical infrastructure. It requires organizational readiness, institutional alignment, and inclusive stakeholder engagement.

7.2 Contributions to knowledge

This research contributes empirical insight into how AI initiatives are operationalized within a real-world public sector setting. It extends the existing literature by offering a cross-theoretical analysis that connects socio-technical frameworks with lived implementation experiences. It also highlights the evolving relationship between public innovation strategies and practical constraints.

7.3 Practical Implications

The findings offer actionable strategies for future AI initiatives in government. These include improving in-house technical oversight when outsourcing, strengthening data practices, aligning political vision with technical feasibility, and investing in ethical governance and cross-agency collaboration.

7.4 Limitations

This research is subject to several limitations inherent in its design. Firstly, the research is based on a single case study in Estonia and a small sample of participants. This sample size does not encompass the entire spectrum of relevant actors. Notably, specific attempts to include perspectives from a ministry currently implementing BüroKratt were unsuccessful due to access constraints. This represents a know gap in understanding implementation challenges from a direct user-agency viewpoint. While the case offers rich insights, its findings may not be fully generalizable. The study also focused on internal perspectives, without citizen feedback or longitudinal assessment. Finally, as with any qualitative inquiry, the potential for researcher bias exists. While a commitment to reflexivity was employed in order to mitigate this, the interpretive nature of analyzing qualitative data means the researcher's own perspectives could invariably influence the findings.

7.5 Future Research

Further research could explore citizen experiences of AI-enabled services, assess the long-term impacts of initiatives like BüroKratt, or conduct comparative studies across countries with different digital maturity levels.

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