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Technical Adaptation of e-Cabinet - An Architecture Based on GovStack Building Blocks and Standard Practices

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e-Kabineti Tehniline Kohandamine - Arhitektuur GovStacki Ehitusplokkide ja Standardpraktikate Põhjal

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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.

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Abstract

This dissertation presents the critical factors that must be considered for the successful development and implementation of an e-Cabinet system. The paper combines a comprehensive literature review with interviews with technical experts to identify essential and other building blocks, architecture, and best practices. It proposes the key building blocks for the e-Cabinet system, such as Digital Registries, Registration, CMS, DMS, Workflow Engine, and Notification system. In addition, a hybrid architecture of microservices and layered architecture is proposed. In addition, the paper highlights the importance of standard practices, such as API standardization, PKI, LDAP, ISO standards, and database standards, in assuring the interoperability, security, and industry best practices of a system.

This thesis is written in English and is 85 pages long, including 9 chapters, 4 figures and 5 tables.

List of abbreviations and terms

2FA	Two-factor Authentication
ABAC	Attribute-Based Access Control
API	Application Programming Interfaces
BB	Building Blocks
BI	Business Intelligence
CA	Certificate Authority
CMS	Content Management System
DMS	Document Management System
DSA	Digital Signatures Act
eDMS	Electronic Document Management System
FTS	Few Times Signature
GDPR	General Data Protection Regulation
HBS	Hash-Based digital Signature
HIPAA	Health Insurance Portability and Accountability Act
ICT	Information and Communication Technology
IM	Information Management
ISO	International Organization for Standardization
LDAP	Lightweight Directory Access Protocol
MTS	Many Times Signature
OTS	One Time Signature
PKI	Public Key Infrastructure
POT	Parliamentary Oversight Tool
RAID	Redundant Array of Independent Disks
RBAC	Role-Based Access Control
REST	Representational State Transfer
SOA	Service-oriented architecture
SOA	Service-oriented architecture
WfMS	Workflow Management System

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1 Introduction

People's perceptions of how competent their governments are in offering high-quality, real-time digital services are shifting as a result of how the public sector is experiencing a digital transformation. Governments are altering their modes of operation to improve public service delivery, be more effective and efficient in their designs, and accomplish goals like increased transparency, interoperability, or citizen satisfaction in response to shifting expectations and because of supranational agreements (Mergel et al., 2019). Most countries and governments in the world have some similar characteristics. The public management concept is that public administrators should aim to build a collective understanding of the public interest, rather than focusing on individual solutions (Denhardt & Denhardt, 2000). The goal should be to create a shared sense of responsibility and interest among the public. The primary focus should be on achieving the public interest as the goal, rather than treating it as a by-product of individual choices (Denhardt & Denhardt, 2000). This allows a country to establish the requirements to develop public services. The structural transition to digital transformation in the public sector is viewed as a powerful facilitator for data-driven culture, proactive inclusivity, and efficiency, to name a few. Several agendas, campaigns, and working groups were formed to promote digital transformation; nevertheless, many of the participating nations were unable to effectively reconstruct the core elements of the existing procedures. On the other hand, services can be based on society's most important (Al-Omari & Al-Omari, 2006). Now a day, E-governance strategies are common in most countries (Saxena, 2005), however, different countries have different approaches, technologies, and concepts. The GovStack open-source initiative was to assist, coordinate, and advance digital development (*GovStack*, n.d.). The GovStack steps in as a standardization to develop a shared understanding of sustainable and interoperable components of e-service to create human-centered digital services known as Building Blocks (BB) (*GovStack*, n.d.). The International Telecommunication Union (ITU), Estonia, the Federal Ministry for Economic Cooperation and Development, Gesellschaft für Internationale Zusammenarbeit (GIZ), and the Digital Impact Alliance are the main initiators of the

multi-stakeholder GovStack initiative, which was developed to hasten the digital transformation of government services (*GovStack*, n.d.).

A well-known strategy in the process of digitization is to start with local projects and initiatives at the public and private company levels (Mechitov & Moshkovich, 2021). In other words, the process of developing systems by small components such as software bundle, online service, web resource, or module that collects many connected functions (or data) can be called building blocks (Žitnik et al., 2022).

Adaptation of GovStacks' BBs can lead to a standard way to develop e-services. The digital transformation of a country can start from different aspects starting from digital registries, identification, and registration, payment, security, and even the implication of artificial intelligence. This can be the digitalization of political aspects as well. The concept of the e-Cabinet comes as a part of it. As mentioned earlier, every country has chosen different ways to develop e-services based on the aspects of the individual country (Denhardt & Denhardt, 2000). In addition to that, the building blocks required to develop the e-Cabinet should depend on the government structure and the hierarchy of the government. Previously there were studies of the digital transformation of a Country such as Estonia (Margetts & Naumann, 2017), and India (Mohan Prakash & Kethan, 2018) which mention e-Cabinet as a part of the digitalization journey. However, the identification of building blocks essential for e-Cabinet is still vague. Moreover, the GovStack initiatives and building blocks are not mentioned in e-Cabinet-related studies. Though Žitnik et al. (2022) have mentioned the building blocks necessary to develop an interoperable system, it is limited to the use case used for an interoperable system. Therefore, to develop an e-Cabinet system, it is important to identify the building blocks essential to develop it. This can facilitate moving forward with standardizing the building blocks chosen to correspond with the GovStacks' building blocks.

1.1 Objective

This study aims to analyze and identify the building blocks needed to develop an e-Cabinet system and match them with GovStack’s BBs. Before constructing the BBs necessary to develop the e-Cabinet system, this research will also describe the technological needs, such as digital standards and ICT infrastructure. The study will continue from the perspectives of Estonia, Canada, India, Singapore, and Mexico to

determine the BBs required for the e-Cabinet system among various nations. This study can also be useful to policymakers.

The fundamental purpose of this study is to identify the building blocks required for the development of the e-Cabinet and to propose a technical architecture that includes the required building blocks for the development of an e-Cabinet system.

Moreover, this study can be beneficial for countries that don't have any e-Cabinet system developed yet, or any country which is trying to develop an e-Cabinet system based on GovStacks' BBs. Additionally, this research can aid nations in creating the ICT infrastructure and other standards necessary to create an e-Cabinet system.

By taking BBs as the context of GovStack, we examine the adaptability of BB and the design of technical architecture for the e-Cabinet system by addressing the following research questions.

1.2 Research Questions

These are the two primary research questions (RQ) and four sub-research questions (SRQ) that must be addressed.

RQ1. How to design cabinet infrastructure for a country?

> *SRQ1.1. What are the BBs used for the development of e-Cabinet in different chosen countries?* The development of e-Cabinet in different chosen countries requires a set of building blocks, which are the basic components or elements that form the foundation for building the e-Cabinet system. Depending on variables like as technical infrastructure, government legislation, and user needs, the building blocks utilized to establish an e-Cabinet in different countries may vary. To design an e-Cabinet system, it is crucial to choose and combine the proper building blocks that match the country's and users' particular requirements.
>
> *SRQ1.2. What are the necessary standards followed by the chosen countries?* To guarantee the system's interoperability, security, and dependability, the creation of an e-Cabinet system must adhere to certain criteria. The standards offer a standardized foundation for designing, developing, and implementing e-Cabinet

systems. Depending on their technological infrastructure, legislative framework, and user needs, many nations may have distinct e-Cabinet development standards.

SRQ1.3. What are the technical standards which need to be followed? To secure the system's interoperability, security, and dependability, the creation of an e-Cabinet system must comply with certain technological requirements. Technological standards offer a consistent foundation for designing, developing, and implementing e-Cabinet systems. Depending on their technological infrastructure, legislative framework, and user demands, many nations may have distinct technical standards for e-Cabinet development. For instance, it can be the standardization of platform and operating systems, databases, use of web standards such as HTML, JavaScript, and CSS3, security standards, interoperability standards such as standardization of API, and use of XML.

RQ2. How are the ICT infrastructure and standards related to the essential building blocks?

SRQ2.1. What are the minimum technical requirements to have for the essential building blocks of an e-Cabinet? The e-Cabinet system's essential building components are inextricably linked to the ICT infrastructure and standards. The building blocks offer a collection of essential fundamental features and components for developing and operating an e-Cabinet system. The ICT infrastructure and standards offer the technological basis and guidelines required to deploy these building blocks successfully and efficiently.

The ICT infrastructure refers to the technological resources and infrastructure required to support the e-Cabinet system. This covers the hardware, software, networks, and other components necessary for the functioning of the system. To meet the e-Cabinet system's needs, the ICT infrastructure must be dependable, scalable, and secure. The standards offer a standardized foundation for designing, developing, and implementing e-Cabinet systems. The interoperability, security, and dependability of the e-Cabinet system are facilitated by standards. Using standards ensures that e-Cabinet systems are interoperable with other systems and technologies and can successfully communicate data and information. Elements such as document management, workflow management, access control, security, and audit trails are fundamental to the development of an e-Cabinet

system. Certain technologies and standards, including database management systems, web services, and digital signature standards, are required to deploy these building pieces. The ICT infrastructure and standards offer the essential basis for implementing these components. The usage of a certain database management system, for instance, may support the document management building block, whilst the use of web services can assist the workflow management building block. The adoption of digital signature standards can assist the security pillar, while access control and audit trail standards can help the access control and audit trail foundations.

2 Research Methodology

This chapter offers an outline of the research approach and methodology used in this dissertation. The purpose of a detailed description and justification of the chosen methodology and the protocols we used to process our data is to assist the reader through the body of our writing and enable him or her to comprehend the chain of presented results and arguments, their structure, and their implications.

Typically, design research should be conducted in order to develop or propose a software architecture. Design research is a methodical and iterative process of investigating, analyzing, and evaluating design problems to develop and propose effective solutions (Bayazit, 2004). Design research for software architecture development may entail a variety of techniques and methodologies, including surveys, interviews, observations, prototyping, and user testing (Bayazit, 2004; Buchanan, 2001; Edelson, 2009). These techniques are employed to collect information regarding user requirements and preferences, as well as to generate ideas and evaluate design solutions.

In the case of developing or proposing a software architecture, design research may entail analyzing business or user requirements, identifying relevant technologies and frameworks, developing and testing prototypes, and evaluating the performance of existing software solutions (Bayazit, 2004; Buchanan, 2001; Edelson, 2009; Koskinen et al., 2012).

2.1 Data Sources and Data Collection Procedure

The research of this dissertation employs research design concepts to guarantee that the proposed architecture contributes to the e-Cabinet system and the legal acts drafting process.

This dissertation focuses on the use cases and digitalization journey of Djibouti and the development of the e-Cabinet system in Djibouti. At first, the building blocks are identified based on primary data collected from the e-Cabinet development in Djibouti. Then the required ICT infrastructure for e-Cabinet development has been designed based on the required building blocks. For building block implementation and identification, there were uses of narrative review (Huybrechts et al., 2021). A systematic literature

review (Almeida et al., 2020) was used to describe the functionalities of the building blocks. The use of the case study (Schildkamp et al., 2020) can also be seen as its reference. Specialists in the relevant technically sound specialist using GovStack have been interviewed for this study (Larsson & Grönlund, 2016). The interview questions are based on hypothetical situations and events that will aid in gaining a deeper knowledge of the e-Cabinet system, its operation, its components, and its influence on the decision-making process of governments. In addition, prior to the performance, questions, and topics were developed based on sustainability as a dialogue of values and the framework described in the preceding section. Digital specialists who have participated in prior e-Cabinet initiatives in digitally advanced nations such as Estonia, Denmark, and Singapore will share their knowledge on the subject and make suggestions for the evaluated case study. In addition, government officials participating in Djibouti's digitalization and the development of the country's e-Cabinet system agenda will offer details regarding the present AS-IS phase of the country's digitalization journey and the strategies created to build the e-Cabinet system. However, improvisation was allowed to explore the subjects as they were offered by the actors. Thus, this study is conducted by first identifying the necessary building blocks and then creating an architecture based on the building blocks (Almeida et al., 2020).

To verify the whole process, an active engagement is maintained in the weekly workshops hosted by stakeholders in Djibouti's e-Cabinet development. The AS-IS digital cabinet workflow in Djibouti has subsequently been shown in a process design. The outcomes of the workshops and expert interviews will be examined and utilized as a guide to define the building blocks of the proposed TO-BE e-Cabinet system model for Djibouti, with the integration of Amphora professional software along X-Road.

The interviews were recorded using Microsoft Teams and Google Meet with the use of the screen sharing feature, which allowed the interview questions to be shared with the informants. This not only guaranteed that the storylines remained on course, but also allowed for a focus on each topic individually, as well as the flexibility to deviate for new questions and then loop back.

The following stages comprise the interview procedure:

i. Developing interview questions in accordance with the research questions and previous findings.
ii. Creating an interview guide.
iii. Conducting recorded interviews.
iv. Transcribing interviews that were recorded.
v. Conducting a thematic analysis of obtained data (Belotto, 2018).

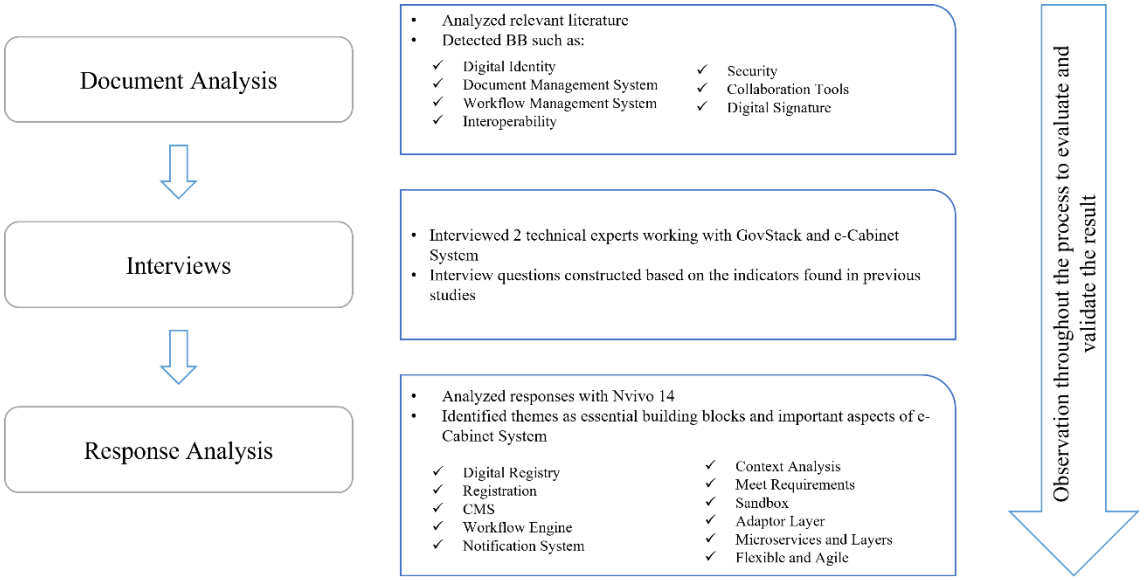

Figure 1: Research Methodology Phases

Along with the work of transcribing and preparing the qualitative data (McLellan et al., 2003) the following steps were taken:

i. The recordings were transcribed by MS Teams transcribing option and for Google Meet interview using a browser extension named Google Meet Transcripts developed by Laxis.
ii. To enable the thematic analysis in NVivo 14, the recordings were transcribed word for word eliminating nonverbal and background noises.
iii. Any nonverbal communication such as gestural communication is omitted.
iv. During the process of the interview, the mispronounced words are transcribed exactly as it is spoken.
v. The transcription was filtered by deleting profanity, slang, grammatical issues, and term or idea abuses. Whenever an inaccurate or unexpected pronunciation

made the text difficult to comprehend, the right term was substituted. This also includes the filtering of words such as “huh, hmm, mmm, yeah”.

It is possible to infer from a variety of journals and publications that the study issue may be addressed using a variety of theories and that the research questions are mostly responsible for this. However, it is important to do a literature review and to get the definitions and factors related to the research. For this research, based on the research questions, it is important to have a mixed method approach which will help to analyze data and provide a solid conclusion.

2.2 Thematic Analysis

Thematic analysis is a prevalent technique employed in contemporary dissertations and is regarded as a fundamental approach to qualitative analysis (Belotto, 2018). This approach exhibits a high degree of adaptability and can be implemented across a range of theoretical and epistemological frameworks. The method of thematic analysis was employed as a supplementary analytical approach during the initial, subsequent, and final rounds of data gathering.

During the initial phase, the open-ended questions in the questionnaire were subjected to analysis, and the primary themes in the expert interviews were identified. During the subsequent phase, the literature review findings were synthesized and organized. The building blocks were initially identified from the literature review and workshop data.

During the third phase, interviews with the experts are conducted. Thematic analysis was performed in the fourth round of the study, utilizing the computer-based software NVivo 14 to analyze semi-structured in-depth interviews with experts. The study employed a hybrid methodology that integrated both inductive and deductive coding techniques across all rounds (Fereday & Muir-Cochrane, 2006). The themes that were identified were derived from data and were not associated with pre-existing codes.

Table 1: Steps of Thematic Analysis

Phase	**Process Description**
Making yourself familiar with your data	If required, transcribe the data, review it again, and make initial notes.
Creating initial codes	Collecting data relevant to each code, and methodical coding of important data aspects throughout the full data collection.
Searching themes	Collecting all information relevant to each prospective subject and grouping codes into potential themes
Reviewing themes	Creating thematic analysis
Identifying and defining themes	Naming and creating precise specifications for each theme.
Finalize	The remaining window of time for analysis

In order to ensure a thorough and comprehensive understanding of the subject and the results obtained, an overview of the building blocks and architectures of the e-Cabinet system is analyzed in this dissertation in Chapter 3 along with the standard practices in Chapter 4. The present chapter only provides an overview of the methodology, steps, and instruments employed, along with the background behind this study's path.

3 Literature Review

The literature on e-governance has something to say about how connections with people and other stakeholders have changed. Numerous iterations of coding and a thorough analysis of the expert interviews reveal that at all levels of government, external rather than internal demands are primarily what drive the demands for digital transformation in public administration. This is especially true when it comes to changes in the environment, technology, and requests from stakeholders (Mergel et al., 2019). Implementing e-governance increases the role of the citizen since they are perceived as co-producers of services rather than passive consumers (Mergel et al., 2019). When it comes to sustainable digitalization, is related to the political framework (Martens & Zscheischler, 2022). The way it is molded politically and legally will rely on how the players that have sway evaluate and view the advances of digital transformation. Systems used in the public sector's large data economy deal with massive volumes and varieties of data. If this information cannot be accurately comprehended, retrieved, or merged, it is meaningless. Following the same concept, Estonia continued the digitalization journey with the development of the e-Cabinet (Margetts & Naumann, 2017).

3.1 e-Cabinet

The concept of the e-Cabinet is to go paperless (Margetts & Naumann, 2017; Mohan Prakash & Kethan, 2018). A government's decision-making process can be supported by electronic technology such as e-Cabinet. It is a digital technology that is utilized to regulate, store, and disseminate sensitive and private information pertaining to government operations. To increase efficacy and efficiency, the e-Cabinet system is meant to take the place of conventional paper-based information management techniques. Government representatives, ministers, and other decision-makers frequently use the electronic cabinet system. Via the system, these people may get access to pertinent data such as briefings, reports, and cabinet files whenever they want, and participate from anywhere (Dadhichi, 22021; *Nextsense - E-Cabinet Software Solution*, n.d.). Government personnel are better able to collaborate and communicate, which aids in their decision-making. The ability to speed up the decision-making process is one of the key advantages

of the e-Cabinet system. The solution can aid in accelerating decision-making and reducing delays by giving government personnel real-time access to information. Also, it makes it possible for government representatives to interact and decide more efficiently. For instance, Estonia is the first nation in the world not to use paper for cabinet discussions or to draft legislation. As a consequence, sessions now last between 30 and 90 minutes instead of the usual 4-5 hours (Margetts & Naumann, 2017). The e-Cabinet system can also aid in lowering the expenses connected with conventional paper-based information management. The technology can aid in lowering the cost of printing, copying, and storing information by doing away with the requirement for physical storage and paper-based documents.

A safe platform for sharing sensitive information is offered by the e-Cabinet system for government employees. The system is normally only accessible to authorized individuals, and all action is recorded and audited to guarantee security and adherence to applicable rules and regulations. Moreover, the system may have security protections to safeguard sensitive data, like encryption, PKI-based authentication, and other safeguards (Margetts & Naumann, 2017). There are several countries such as India (Mohan Prakash & Kethan, 2018), and Canada (*Cabinet Affairs - Canada.Ca*, 2020) which have implemented e-Cabinet systems like Estonia. Early signs of this kind of dramatic service change toward platforms, smart goods, and customer requirements may be seen in the public sector: Several phases of the shift from paper-based to the digital government have previously taken place, frequently in response to waves of ideological movements in public policy and public management (Mergel et al., 2019). However, it is becoming increasingly crucial not to just rely on the advancements of current technology management, since digitization initiatives offer significant gains for public sector organizations to become more effective and efficient in their operations and outputs (Mergel et al., 2019). The preliminary literature review shows that the past studies are focused on digital transformation as an overall perspective or in other sectors such as agriculture (Martens & Zscheischler, 2022). In certain research, the issues preventing the virtualization of government-to-citizen e-government procedures are investigated by evaluating the intent of citizens to utilize or oppose the government's virtualized processes (Seth Ackom et al., n.d.). In terms of methodologies, some articles used a discourse analytical approach (Martens & Zscheischler, 2022). There are studies that used a use-case approach (Žitnik et al., 2022), with few studies using inductive, interpretive interview case studies, which

are ideal for gaining a deeper understanding of eGov practice (Larsson & Grönlund, 2016). Mergel et al. (2019) adopted an interpretive position with the goal of comprehending their perspectives, strategies, and actions in the domain of digital transformation. From the case studies, it is possible to identify the essential list of Building blocks for e-Cabinet, however, till the present time, there is no research available, which can provide such information. The only helpful information would be the structure of the government mentioned (Margetts & Naumann, 2017) with the definitions of e-Cabinet (Margetts & Naumann, 2017; Mohan Prakash & Kethan, 2018).

Ultimately, the e-Cabinet system is a crucial tool for contemporary governments aiming to enhance their decision-making processes and save expenses connected with conventional paper-based information management techniques. It makes it possible for government representatives to communicate and collaborate better, obtain information more efficiently, and make more informed decisions.

3.2 Technical Adaptation

Technical adaptation is the process of changing or modernizing technology to better meet the demands of a user or an organization. This could entail modifying the hardware, software, or other technical elements to enhance functionality, boost performance, or fix compatibility problems. The adoption of new technology that can improve operational efficiency, lower costs, or improve user experience are different example of technical adaptation. Because of the rapid evolution of technology and the necessity for organizations to remain up with shifting consumer demands and fashion trends, technical adaptation is frequently required. Making decisions on whether changes are required to obtain desired results demands having a deep understanding of the user requirements, the capabilities of new technologies, and the existing technology infrastructure. The ability of parliaments and their members to employ digital technology to encourage more connection with the public and its communities is becoming more widely known. To first get to the concept of e-Cabinet we can compare its implication with the e-parliament concept. A legislature that is given the ability to use ICT to be more open, accessible, and responsible is known as e-parliament (United Nations et al., 2008 as cited in Papaloi & Gouscos, 2011). The parliamentarian's active involvement can also play an important role

in the development of an e-parliament. As an illustration, the Scottish parliamentarian's enthusiastic response and the gathering of constructive input can make the development process smoother (Armstrong, 2022). Switzerland has implied electronic parliamentary voting for legislation which is believed to provide transparency (Benesch et al., 2018). The parliaments of Ghana, Kenya, Uganda, and Zambia have implemented digitalization with POT (Parliamentary Oversight Tool) for better transparency, agility, and ownership (Kgothatso Semela et al., 2023) where the parliamentarians were directly involved. Furthermore, consultation administration equipped to offer qualified assistance in lawmaking and policymaking supports decisional parliaments as governing legislatures that take the initiative in developing policy and monitoring its execution (Romanelli, 2016).

Based on the previous studies it can be said that for providing strategic direction and managerial control, an apex committee under the Cabinet Secretary or responsible person should be established. There is a need to have an accurate database of every citizen and a well-developed infrastructure. Technical security must be used to assist highly cautious handling of security concerns. The political will and societal acceptance of e-Government, not just in metropolitan but also in rural regions, are of utmost importance. The availability of ICT infrastructure is one of the key differences between e-governance in industrialized and developing nations. The availability of internet technology, which made it feasible to access governmental institutions remotely and affordably, was a major factor in the e-governance movement in industrialized nations. However, government organizations were already utilizing ICT-based systems for their internal operations. Moreover, because of the low rate of ICT adoption in the public sector in emerging nations, their ICT infrastructure was inadequate (Saxena, 2005).

3.3 Building Blocks

The usage building blocks concept in e-services is already known (Mecella & Pernici, 2001), however, it follows an approach developed by different organizations or countries. Digitalization frequently results in a shift of goods towards integrated solutions in addition to making them smarter and more connected (Lichtenthaler, 2020). A building block method in e-service development is the breakdown of the overall system into

smaller, reusable components or modules that may be combined into a bigger system (Almeida et al., 2020). This approach differs from conventional system development methods, which involve creating systems from scratch, often without an emphasis on modular design or reusability.

In e-service development, the building blocks approach is beneficial since it permits more flexibility and agility (Almeida et al., 2020). Rather than having to establish a new system from scratch every time a new e-service is required, developers may easily create new e-services by reusing existing building blocks. This may minimize development costs and time, as well as make future updates and modifications to e-services simpler. Moreover, the building blocks methodology is compatible with agile development approaches, which stress iterative development and frequent releases. Building blocks can contribute to the standardization of the development of e-services, ensuring that best practices and common functionalities are utilized across applications. This results in better consistency and interoperability among e-services, making them easier to navigate and utilize.

Using application programming interfaces (APIs) is one example of a building-blocks method in e-service development (Puspitasari et al., 2021). APIs are defined protocols that enable software programs to interact with one another. With APIs, developers may construct e-services that connect with other systems or services already in existence. With a mapping API.

Open-source software is another example of a building block method in e-service development. Open-source software is software that is freely accessible for use, modification, and distribution by anyone (Hahn, 2002). By using open-source software, developers may use existing code libraries and frameworks to save expenses and accelerate development. For instance, rather than developing a customized content management system (CMS) from scratch, a developer may establish a website for an e-service using a CMS using an already-built framework to develop CMS.

In contrast to the building blocks approach, conventional system development techniques in many nations include the creation of project-specific, custom-built systems. This method may be time-consuming and expensive, as well as difficult to adapt or upgrade in the future. Depending on considerations like security concerns or the need for flexibility,

conventional development methods may be preferable for certain projects or sectors. The building block approach to e-service development has a number of benefits over conventional development methods. With modular design and reusable components, developers may construct more adaptable, scalable, and cost-efficient e-services. However, the building blocks required for the development of e-Cabinet are not identified or mentioned in any individual research. As a result to that, there are no technical aspects, requirements, or standards mentioned in any previous studies. However, based on the e-parliament and functionalities of the e-Cabinet we can say the building blocks of an e-Cabinet system should consist of information management, security, collaboration and communication tools, access and authentication, integration to other systems (Armstrong, 2022; Margetts & Naumann, 2017; Papaloi & Gouscos, 2011; Pappel et al., 2021). Moreover, there are ICT solution-providing companies that provide e-Cabinet system solutions mentioning the functionalities such as digital signing, document management, information versioning, standardization, dynamic approval, building blocks concept, interoperability, workflow, and user interface (*Nextsense - E-Cabinet Software Solution*, n.d.). Based on the functionalities, the building blocks can be identified as digital identity, document management system, decision support system, workflow engine, security, and interoperability.

3.3.1 Digital Registry

The construction of a digital registry is a crucial element within e-Cabinet frameworks, which serve to retain and oversee data pertaining to individuals, entities, and resources. The digital registry is a centralized database that offers an all-encompassing perspective of data pertaining to entities, encompassing their identity, attributes, and operations (GovStack, 2023). Moreover, it can be utilized to streamline a multitude of procedures, including but not limited to the integration of fresh users, allocation of roles and authorizations, monitoring of ownership and utilization, and administration of resource accessibility.

The digital registry building block encompasses various essential functions, including but not limited to entity identification, registration, and management (Ferriero, 2016). The process of entity identification pertains to the allocation of distinct identifiers to various entities, including but not limited to individuals, businesses, and assets, with the aim of

streamlining their monitoring and administration. The process of registration entails the gathering and authentication of data pertaining to entities, including but not limited to their appellation, domicile, means of communication, and lawful standing, with the aim of ascertaining their precision and comprehensiveness. The process of management encompasses the task of preserving and revising data pertaining to various entities, which includes their characteristics, connections, and operations, throughout a period of time.

The digital registry building block is a crucial constituent of e-Cabinet systems, facilitating the retention and administration of data pertaining to entities, encompassing their identity, attributes, and operations. To sum up, its significance cannot be overstated. The digital registry facilitates efficient information management and decision-making by serving as a centralized repository for entity information, thereby supporting diverse processes and workflows. Moreover, the integration of the digital registry with other building blocks can lead to the development of more efficient and streamlined e-Cabinet systems.

3.3.2 Registration

Registration is an essential component of the e-Cabinet system because it facilitates the registration of vital information and credentials. Two parties are involved in the registration procedure: the applicant and an authorized registrar representative. The applicant receives a credential that functions as evidence of registration in exchange for providing information and/or credentials issued by public or private entities. In order to assert/confirm the applicant's information, the registration procedure may also involve third parties, such as notaries, family members, witnesses, public entities, or databases.

The registration building block is crucial because it facilitates the development of a digital registry where data can be stored and accessed securely. This registry is a third party that participates in the registration process. Using a digital registry can help eliminate the need for paper-based records, thereby improving the efficiency and cost-effectiveness of the registration process.

In addition, the registration building block enables the implementation of a single-window system in which a candidate can register information with multiple registries and

receive multiple credentials while only providing information and payment once (GovStack, 2022b). This can significantly reduce the burden on applicants and improve the overall efficacy of the registration process.

The registration building block is an integral component of the e-Cabinet system that facilitates the secure and efficient registration of data and credentials. Its implementation can eliminate the need for paper-based records, lessen the burden on applicants, and improve the overall effectiveness of the registration process.

3.3.3 Digital Identity

Digital identity, also known as electronic identification or e-ID, is a method of electronically or digitally verifying an individual's identity. This method involves the use of unique identification identifiers, biometric data, or other authentication methods to affirm an individual's identity in online transactions or interactions (Addo & Senyo, 2021; C. Sullivan, 2018). It also requires the use of an electronic document or smart card containing the user's identification information, which can be verified online. E-ID can be used to access online government services, banking transactions, and other online activities that require identity verification (Addo & Senyo, 2021).

Due to their convenience and security, digital and electronic identification systems are gaining popularity. These systems are more efficient and accurate than conventional identity verification methods, such as paper IDs or passwords (Campbell, 2020). In addition, they enhance privacy protection by reducing the need for individuals to disclose personal information to multiple organizations. Additionally, it has the potential to improve security and decrease fraud. These systems can substantially reduce the risk of identity theft and fraud by employing biometric data or unique identification numbers.

Digital ID and e-ID provide individuals with a secure and convenient method to authenticate their identity online is becoming increasingly essential as more aspects of our lives migrate online. This includes accessing online services, undertaking financial transactions, and taking part in online voting and e-signature (C. Sullivan, 2018). Digital ID and e-ID can also help reduce identity theft and fraud because they provide a more secure method of establishing identity than traditional methods such as usernames and

passwords. It is also essential to data exchange or interoperability since it provides a standardized method of identification across various systems and platforms (Campbell, 2020; C. Sullivan, 2018). In the absence of a common identification system, it is difficult to verify the identities of users gaining access to different systems, resulting in security hazards and data breaches. With digital ID and e-ID, users can be identified and authenticated across multiple systems and platforms, ensuring a safe and seamless exchange of data. In turn, this promotes the efficient and effective operation of interconnected systems, allowing for greater collaboration and coordination across organizations and sectors. Digital identity is an essential component of an e-Cabinet system for several reasons. It ensures that only authorized users have access to sensitive information and decision-making processes by enabling secure authentication and access control. This aids in preventing unauthorized access and maintaining the secrecy of government affairs. It also allows the generation of e-signatures, which are essential for the signing of digital documents and contracts in an e-Cabinet system. In a paperless environment, these signatures provide a legally binding method to endorse documents and decisions. Thirdly, digital ID and e-ID enable secure and seamless communication between various government agencies and departments, thereby fostering interoperability and productive exchange of information. Overall, digital ID and e-ID are essential to the development and implementation of an e-Cabinet system, ensuring its efficacy and safety.

Overall, digital and e-ID systems are a crucial component of the digital economy, providing a secure and trustworthy method for individuals to verify their online identity. They have the potential to revolutionize how we interact with online services and provide individuals and businesses with greater convenience and security.

3.3.4 Information Management

Information management (IM), which involves the gathering, storing, organizing, retrieving, and disseminating of information, is an essential part of every organization's activity (Jarvenpaa & Ives, 2015). Making sure information is accurate, secure, and accessible when needed enables informed decision-making and enhances organizational performance. The use of digital records and document management systems (DMS) to handle governmental records and documents is a crucial component of IM in e-governance. This can assist in ensuring that government records are accurate,

comprehensive, and easily available, which is crucial for accountability and transparency (An, 2009). By streamlining record-keeping and lowering the demand for physical storage space, the use of electronic document management systems can also help to enhance efficiency and lower costs. The use of data analytics and business intelligence (BI) tools to analyze and visualize government data, which can offer insights into trends, patterns, and performance indicators, is another crucial component of IM in e-governance (Airinei & Homocianu, 2010). This can assist government organizations in identifying opportunities for development and assisting them in making defensible choices to enhance service delivery.

Ensuring the security and privacy of government data is another important aspect of effective IM in e-governance. This necessitates putting in place the necessary information security measures, like authentication, encryption, and recurring security audits (Margetts & Naumann, 2017). It also necessitates adherence to pertinent data protection laws and standards, such as the Health Insurance Portability and Accountability Act (HIPAA) in the US and the General Data Protection Regulation (GDPR) in the EU (Labadie & Legner, 2023).

In summary, the success of e-governance efforts depends on successful IM. To protect government information, it is necessary to employ relevant tools and technologies, such as DMS and BI tools, and to adopt suitable information security procedures. Government operations can become more efficient and productive with the help of e-governance initiatives that put a high priority on effective IM.

3.3.5 Document Management System

In the current digital era, document management systems have become a necessity for businesses across all industries. A document management system (DMS) is a software application that stores, manages, and tracks digital documents, images, and other forms of digital content. It provides a central repository for the secure storage, organization, and retrieval of documents (Mahmood et al., 2017; Manoj et al., 2015).

A document management system's value resides in its capacity to expedite document-based workflows, enhance collaboration, and enhance data security. With a DMS,

organizations can centrally store documents of various forms, including text documents, spreadsheets, presentations, images, and videos, among others (Sprague, 1995). This enables employees to swiftly locate, access, and retrieve information without having to sift through multiple file locations or communications (Mahmood et al., 2017). DMS also facilitates the automation of document-based operations, thereby enhancing productivity and decreasing response times (Mahmood et al., 2017). This is particularly helpful for organizations where multiple individuals are involved in the evaluation, approval, and distribution of documents. A DMS also provides a secure and compliant environment for accumulating classified documents, which is an important advantage (Manoj et al., 2015). Document management systems have comprehensive security features that restrict access to sensitive data to authorized personnel only. A complete audit trail of all changes made to a document is also kept, which may be utilized for regulatory reasons (Mahmood et al., 2017). This is essential in the healthcare sector, financial services, and legal services, where document privacy and security are crucial.

Since an e-Cabinet system refers to the use of digital platforms to store and manage documents, ensuring secure, quick, and dependable information access, using e-Cabinet systems has several advantages, including reduced paper consumption, efficient document administration, increased transparency, and streamlined decision-making procedures.

With an e-Cabinet system, government officials can access documents across any location, on any device, at any time (Dadhichi, 22021). This facilitates the streamlining of decision-making processes, as officials can swiftly and easily access the necessary documents. In addition, e-Cabinet systems reduce the time and resources needed to process and store physical documents, which can be time-consuming and expensive. The e-Cabinet systems offer advantages beyond merely storing and managing electronic documents. They also contribute to the improvement of government transparency by facilitating citizen access to public documents. The use of e-Cabinet systems also promotes cooperation among government officials, making it simpler for them to share information and collaborate on significant projects.

The ability of e-Cabinet systems to improve data security is a further significant advantage. e-Cabinet systems offer a secure platform for storing and administering the enormous quantity of sensitive information held by governments. With features such as

role-based access control, encryption, and user authentication, e-Cabinet systems ensure that only authorized personnel have access to sensitive data. Finally, document management systems are indispensable for organizations in all sectors. They offer a centralized portal for storing, administering, and monitoring electronic documents, thereby enhancing data security and efficiency. Governments are transitioning to e-Cabinet systems, which provide a secure and efficient infrastructure for preserving and managing public documents, in response to the growing demand for secure and efficient document management. e-Cabinet systems offer numerous advantages, such as increased transparency, enhanced collaboration, improved decision-making processes, and enhanced data security. As a result, e-Cabinet systems are becoming an essential component for governments around the globe seeking to improve operations and service delivery to citizens. The Estonian government uses Amphora DMS, a complete electronic document management system that handles production, approval, publication, distribution, and archiving (Pappel et al., 2019). Several Estonian government agencies, including the Ministry of Finance, Ministry of Education and Research, and Ministry of Agriculture, have effectively implemented the Amphora DMS (Pappel et al., 2019).

3.3.6 Workflow Management System

A crucial element of an e-Cabinet system is the workflow management system (WfMS). It is a software tool that automates document-based workflows by defining, executing, and managing a series of tasks or activities necessary to complete a particular business process (Sadiq & Orlowska, 1997). From initiation to completion, the system manages and monitors the flow of activities and duties within a process. It offers organizations a streamlined and efficient method for managing complex business processes. In the context of an e-Cabinet system, the workflow engine ensures that documents are routed to the appropriate individuals or departments for evaluation, approval, and distribution. WfMS is intended to automate workflows, supplanting manual, and paper-based procedures. It allows businesses to model, design, execute, and monitor workflows across departments and functions. Typical components of a WfMS include modeling, execution, and monitoring (Kappel et al., 2000; Sonntag & Karastoyanova, 2010). Creating a graphical representation of the workflow process constitutes the modeling component of a WfMS (Sonntag & Karastoyanova, 2010). It enables users to define the sequence of

activities, the conditions and norms for routing and processing, and the data required at each stage. Frequently, the modeling tool employs a graphical user interface (GUI) to facilitate the visual creation of workflow processes (Nascimento et al., 2002). This makes the workflow procedure simpler to comprehend and communicate to other stakeholders.

The execution component of a WfMS is responsible for carrying out the workflow procedure. The system automatically assigns assignments to the appropriate individuals or departments for processing once the workflow has been defined. The system can also be configured to manage process exceptions and errors (Mohan et al., 1995). The core of the WfMS, the execution component is responsible for automating the workflow process and ensuring that assignments are processed efficiently and accurately. The monitoring feature of a WfMS provides insight into the workflow process. Users can trace the status of assignments and activities, identify obstacles, and monitor the system's performance (Vahi et al., 2012). The monitoring tool frequently employs dashboards and reports to provide users with real-time updates on the workflow's progress (Vahi et al., 2012). WfMS offers numerous advantages to organizations. Enhanced efficacy is one of the major advantages. Through the automation of workflows, WfMS eliminates manual routing and processing, thereby reducing errors and delays associated with paper-based processes. This not only improves the workflow process's efficacy but also reduces the time and resources required to complete particular duties or processes. Improved accuracy is another important advantage of using a WfMS. By automating workflows, WfMS ensures duties are completed consistently and accurately. In addition to enhancing productivity and precision, a WfMS also improves workflow visibility and control. It enables administrators to monitor the status of duties in real-time, identifying obstacles and problems that could affect the system's performance. This helps to enhance decision-making processes by equipping stakeholders with the information they need to make rapid, well-informed decisions.

Overall, a WfMS is a potent instrument for organizations seeking to automate business processes and enhance productivity, accuracy, and conformance. By providing greater visibility and control over workflows, WfMS helps to streamline operations, reduce costs, and enhance the organization's overall performance.

Workflow management systems are essential to e-Cabinet systems because they facilitate the automation of document-based processes, which serve as the system's foundation. In

an e-Cabinet system, among other duties, documents are created, reviewed, approved, and archived. These tasks frequently involve multiple parties, and workflow management systems support the flow of documents and duties among these parties. The incorporation of a WfMS into an e-Cabinet system enables organizations to automate the complete document lifecycle, from origination to preservation or archiving. The WfMS allows the organization to define the lifecycle of a document, including the tasks required to process it, the norms and conditions for routing and processing, and the data required at each stage. This ensures that documents are processed efficiently and accurately by following a predefined path.

e-Cabinet systems can benefit from workflow management systems in multiple ways.

i. *Streamlined Document Management*: Workflow management systems automate document routing, review, and approval to streamline document management processes. This reduces the amount of manual labor and time required to complete these duties (Studebaker, 2019).

ii. *Improved Efficiency*: Organizations can enhance their operational efficacy by automating document workflows. This allows them to complete additional duties in less time, thereby minimizing bottlenecks and delays in the document lifecycle.

iii. *Enhanced Collaboration*: WfMS enables multiple stakeholders to collaborate in real-time on documents, regardless of their location. This improves communication and collaboration between stakeholders, thereby enhancing decision-making processes and document quality overall.

iv. *Improved Compliance*: By automating document workflows, businesses can ensure documents adhere to predefined rules and regulations, such as security, access control, and retention policies. This ensures compliance with internal policies and external regulations, reducing the possibility of fines and legal issues.

Document workflows in e-Cabinet systems are frequently complex and involve multiple stakeholders, departments, and systems. WfMS enables organizations to automate these

procedures, ensuring that documents are processed efficiently and accurately by following a predefined path. This enhances the overall effectiveness of the e-Cabinet system, reduces errors, and delays, and enhances collaboration and compliance. Consequently, WfMS is essential to the viability of e-Cabinet systems.

3.3.7 Interoperability

The capacity of organizations to interact with one another across data, systems, and processes to achieve shared objectives is at the heart of interoperability. It entails the transmission of data between information and communication technology (ICT) systems to facilitate the sharing of information through business operations (Jimenez et al., 2014). Interoperability is a fundamental principle that underpins the unrestricted flow of products, capital, services, and people. It is based on the ecosystem of interconnected systems and data that allows this to occur. It entails digitizing the public sector, guaranteeing coordination to prevent digital segmentation of data and services, and facilitating the functioning of services. Interoperability is crucial because it promotes efficiency, effectiveness, and user satisfaction (Jimenez et al., 2014). Users can access and use multiple e-services with a single logon thanks to interoperability, which also eliminates the need for multiple registrations and logins. This also makes it simpler for users to navigate various e-services, which reduces confusion and errors. To accomplish interoperability, it is a must to employ standardized protocols and interfaces that allow disparate systems to communicate and collaborate without difficulty (Novakouski & Lewis, 2012). These standards may be developed by government bodies or individual service providers.

It is intended to facilitate secure data transmission between various organizations and government agencies, both within a single country and internationally. Several countries, including Estonia, Finland, and Iceland, use X-Road today, and it has become a model for other nations interested in implementing secure and efficient data exchange systems (Saputro et al., 2020). Using a standard set of protocols, it enables various organizations and government agencies to securely exchange data with one another. At its foundation, X-Road is founded on a set of standardized protocols that ensure data is transmitted securely and reliably between parties. These protocols include encrypted communications, digital signatures, and authentication protocols, all of which serve to

prevent unauthorized access to data and assure the integrity of the data being exchanged. One of the main advantages of X-Road is that it enables organizations to exchange data without the need for complicated data-sharing agreements but following a standard organization agreement. This helps to reduce the time and expense associated with data sharing, and it can also improve the accuracy and completeness of the data being exchanged.

In addition to its technical capabilities, X-Road is particularly noteworthy for its governance model. In many nations, a singular government agency is in charge of developing and running data exchange platforms. However, in Estonia and other countries that use X-Road, the platform is governed by a collaborative governance model including data, service, and organization modeming which involves multiple stakeholders, including government agencies, private sector organizations, and academic institutions. This model ensures that X-Road remains transparent, inclusive, and responsive to its users' requirements. Moreover, a DMS cannot function independently to provide service; therefore, an interoperable system such as X-Road is required to ensure that a comprehensive paperless system is integrated and in working order (Pappel et al., 2019).

3.3.8 Security

A key component of e-governance, which is the use of electronic communication technology to enhance the provision of public services and the overall effectiveness of governmental operations, is e-Cabinet security. E-Cabinet security, as defined above, relates particularly to the safeguards put in place to protect the electronic records and files that are used in government decision-making.

Electronic documents and files are frequently utilized in e-governance for a variety of tasks, including developing policies, making decisions, and monitoring budgets. These records include private information that, if compromised, might have major repercussions for the nation's leaders and people. As a result, e-Cabinet security is essential to maintain the privacy, reliability, and accessibility of these papers.

Governments must put in place robust security measures to shield electronic documents and files from unauthorized access, data breaches, and other security risks to maintain e-Cabinet security. Implementing robust access controls, such as mandating the use of strong passwords, two-factor authentication, and role-based access control, is one of the critical approaches (Yusif & Hafeez-Baig, 2021). This makes sure that only those with permission can access crucial information. Encrypting sensitive data both in transit and at rest is a crucial additional security step (Yusif & Hafeez-Baig, 2021). Using sophisticated algorithms, the technology of encryption transforms plain text into unintelligible code. Because of this, even if someone were to intercept the information, they would have trouble reading or accessing it.

In order to resolve any security flaws, governments must also make sure that their digital infrastructure, including hardware and software, is updated and patched on a regular basis (Yusif & Hafeez-Baig, 2021). This entails putting anti-virus and anti-malware software in place to defend against cyberattacks as well as routine backups and disaster recovery procedures to guard against data loss in the case of a security breach or other unexpected occurrence.

Governments must also train their personnel on best practices for e-Cabinet security, including avoiding phishing emails, using secure passwords, and updating software and systems (Yusif & Hafeez-Baig, 2021). Frequent risk and security audits can also assist find possible weak points and possibilities for development. Government can also use blockchain technology for digital signature which will allow to have secured data (Almendah et al., 2021).

Finally, we can say that governments must adopt a comprehensive and proactive strategy to protect the security and efficiency of their digital operations since e-Cabinet security is a vital part of e-governance. This necessitates continued expenditures on cybersecurity and digital infrastructure, as well as a dedication to fostering accessibility, inclusivity, and transparency across all facets of government operations.

3.3.9 Collaboration Tools

A crucial building block of e-Cabinet could be collaboration tools that allow government officials to collaborate on electronic papers and files in a safe and effective manner. Collaboration tools can have features like version control, commenting, and real-time editing, enabling numerous users to work on the same document concurrently, regardless of where they are located. Microsoft SharePoint can be considered one example of an e-Cabinet collaboration platform. Users can create, store, and manage electronic documents and files on the web-based platform known as SharePoint. Version control, which enables users to follow changes made to documents over time, and access controls, which let administrators limit who can view critical documents, are just two examples of capabilities found in SharePoint. SharePoint may be adapted to the unique requirements of governmental organizations and connected with other tools and systems (Nath & Kanjilal, 2018). Google Docs can be another widely used e-Cabinet collaboration application (Feeney & Welch, 2016). It is a cloud-based platform that enables users to create, edit, and share digital documents in real-time. Several users can work together on a single document at once with Google Docs' features like commenting and revision history. In addition to being adaptable, Google Docs can be integrated with other programs and resources. Additionally, many governments make use of collaborative programs created especially for e-Cabinet security. The United Kingdom, for instance, uses the Electronic Document Management System (eDMS) as a platform to safely manage electronic documents and files (Jones, 2012). The government of Canada uses E-Cabinet tablets through the secret government infrastructure (*Cabinet Affairs - Canada.Ca*, 2020).

In general, e-Cabinet collaboration technologies are essential to e-governance because they let officials collaborate on electronic documents and data in a safe and effective way. Governments may make sure that their electronic papers and files are secure against unwanted access and data breaches by establishing robust access controls, version control, and other security measures. Collaboration among government employees may be facilitated using collaborative technologies, which can also increase productivity, save administrative expenses, and improve communication.

3.3.10 Digital Signature

A digital signature is a cryptographic method that permits the electronic authentication of a document or message. It enables establishing non-repudiation, authenticating the sender, and confirming the accuracy of the content. In the e-Cabinet, digital signatures play a crucial role in securing documents and ensuring their authenticity. The digital signature includes a time stamp, it is always feasible to verify the signing date. A digital signature and time stamp establish a dataset with the document that cannot be changed afterward. Digital signatures replace traditional signatures, ensuring the legitimacy and security of electronic documents (Pappel et al., 2017).

The e-Cabinet makes it simple to create, distribute, and save digital documents. For safe and effective document management, it is widely utilized in corporations, government agencies, and other institutions. In e-Cabinets, digital signatures are used to authenticate the sender, check the accuracy of the information, and guarantee that the signed papers cannot be revoked. The hash-based digital signature (HBS) techniques are reasonably effective and verifiably secure and a one-time (OTS), few-time (FTS), or many-time (MTS) signature scheme is what is referred to as an HBS scheme. One or more OTS/FTS schemes are the building blocks of an MTS system (Shahid & Khan, 2020). Halevi & Krawczyk (2006) proposed the strengthening of the digital signature by randomized hashing technique rather than using standardized signature schemes such as RSA or DSS. A digital certificate issued by a trustable certificate authority (CA) (Jain et al., 2015) is used in the e-digital cabinet's signing procedure. The certificate includes the sender's public key in addition to other pertinent details like the issuer, validity term, and serial number. With their private key, which is safely kept on a digital signature token or smart card, the sender signs the document. Using the sender's public key, which can be found in the digital certificate, the recipient of the document may validate the digital signature. The digital signature is compared to the original document as part of the verification procedure to make sure it hasn't been tampered with. By looking at the digital signature of the CA on the certificate, the receiver may also confirm the validity of the digital certificate (Jain et al., 2015). The Digital Signatures Act (DAS), which was implemented in Estonia in 2000, equates digital signatures to handwritten signatures (Pappel et al., 2017). Digitally signed documents must be accepted by all Estonian authorities. Individual ID cards include two certificates: one for identification and one for digital signatures. Mobile-ID signatures have grown in popularity in Estonia, with over 75,000

users and over 25 million transactions in 2016 (Pappel et al., 2017). There are three varieties of formats used in Estonia for digitally signed documents: BDOC, DDOC, and CDOC (Pappel et al., 2017). BDOC is the newest format and is intended to replace DDOC, whereas CDOC is an encrypted file that contains the data file which can be MS word, excel, or pdf, the recipient's certificate, an encrypted key for data decryption, and other metadata.

The e-Cabinet system can rely heavily on digital signatures since they improve security, effectiveness, non-repudiation, and legality. They are increasingly being used by corporations and government organizations to manage their digital documents safely and effectively. They are essential in verifying the validity and integrity of electronic documents.

3.3.11 Content Management System

The Content Management System (CMS) is a crucial element of the e-Cabinet system, facilitating the effective and systematic administration of content, encompassing multimedia files, images, and documents. The utilization of a CMS facilitates the effortless generation, modification, and dissemination of content by users, while concurrently managing user access and authorizations (Han, 2004).

The CMS building block, when used in conjunction with the e-Cabinet system, offers a safeguarded repository for crucial governmental documentation with different versions, protocols, and regulations (Han, 2004). This arrangement guarantees the protection and privacy of data while simultaneously facilitating authorized personnel's access to information through the version control function. The utilization of the CMS building block is of utmost importance in ensuring efficient content management and organization within the e-Cabinet system. This feature enables prompt retrieval of vital records and information while upholding the confidentiality and safety of data.

3.3.12 Voting

The popularity of the online voting system is rising because of its many benefits over more conventional ones. Efficiency is one of the main benefits of online voting. It allows

members to cast their votes remotely from any location in the world, as opposed to traditional ways of voting, which can be time-consuming and necessitate the actual presence of all members. Particularly for authorities who are stationed in various locations across the nation or the globe, this can save a significant amount of time and effort. There are other technical building blocks included in online voting, which are identification, confidentiality, transparency, certification, and control by the electoral committee (Krimmer, 2014). Finally, there are a lot of advantages to electronic voting, including efficiency, security, and accessibility. Yet, it is crucial to be concerned about the potential dangers and difficulties connected with computerized voting systems and to design them with these problems in mind. It has the potential to significantly improve democratic decision-making and guarantee that all viewpoints are heard with careful planning and implementation.

4 Overview of the most common e-Cabinet Architectures

The term "e-Cabinet architecture" describes the digital cabinet system's electronic architecture for organizing and storing electronic documents. It is a contemporary method of managing files and records that takes the place of old-fashioned paper-based filing systems. The overall architecture of the e-Cabinet system should involve the stakeholder's perspective while developing the system which would provide flexibility and scalability. Service-oriented architecture (SOA) entails designing a system as a collection of loosely coupled services that communicate using standard interfaces (Perrey & Lycett, 2003). SOA offers flexibility and scalability, making it suitable for the development of complex systems such as e-Cabinet (Perrey & Lycett, 2003; Vescoukis et al., 2012). However, to keep the services more agile, reliable, and scalable the Microservices Architecture provides more technical benefits (Hasselbring & Steinacker, 2017; Ramač et al., 2017).

The e-Cabinet architecture is made to increase the efficiency and security of document sharing, storage, and retrieval. To offer a seamless and simple user experience, it combines hardware and software components. The following elements should be commonly found in an e-Cabinet system such as hardware components, software components, user interface, backup and recovery, security, and integration. In the development process and maintenance microservices architecture makes it easy even in strict plans (Ramač et al., 2017). This organizes an application so that it can function as a collection of small independent services. Each service is self-contained and can be independently developed, deployed, and scaled. This method enables flexibility and maintenance ease. Moreover, it offers a number of advantages, along with increased scalability, flexibility, and fault tolerance. Services can be updated or replaced independently without affecting the entire system (Ramač et al., 2017). The use of standardized APIs and message formats enables simple integration with other systems, while the distributed nature of the architecture simplifies deployment in multiple locations or the cloud.

4.1 Standard Practices

The standard practices of the e-Cabinet system can consist of technical aspects such as API standardization, PKI, LDAP, and database standardization.

4.1.1 API Standardization

The consistency, interoperability, and security of APIs are ensured by a set of rules and specifications known as API standards. API standards can ensure that programmers can create applications that can communicate with the system in a reliable, secure, and effective manner in the setting of an e-Cabinet. In this case, micro-service implementation can create better results regarding performance, complexity, and security (Puspitasari et al., 2021). Some common API standards that might apply to an e-Cabinet include:

I. **RESTful API**: REST (Representational State Transfer) is an architectural paradigm for developing web-based applications that use HTTP for client-server communication. RESTful API (Application Programming Interface) is an API that adheres to the REST architectural style. It specifies a set of principles or restrictions for developing scalable, dependable, and user-friendly online services. The interaction between the client and the server in a RESTful API is based on HTTP methods, including GET, POST, PUT, and DELETE. These methods are used, respectively, to retrieve, create, update, and delete resources. An HTTP request, for instance, may be used to obtain a resource, whereas a POST request may be used to create a new resource.

   It is stateless, which means the server does not retain client information between requests (Neumann et al., 2021). Each request includes all the information necessary for the server to process and provide a response. RESTful APIs often use JSON (JavaScript Object Notation) or XML (Extensible Markup Language) in addition to HTTP methods to express data (Neumann et al., 2021). JSON is a lightweight data format that is simple to read and write, and most computer languages support it.

   Several clients, such as web browsers, mobile devices, and desktop apps, may use a RESTful API, which is one of its benefits. They leverage HTTP protocols to enable programs to send queries and get results (Shovon et al., 2018).

II. **OpenAPI**: The OpenAPI Standard is a guideline for creating APIs. OpenAPI is an open standard for developing and specifying RESTful application programming interfaces. It offers consistent terminology for developers, architects, and stakeholders to define APIs, making them simpler to comprehend, consume, and integrate. The OpenAPI standard describes an API's endpoints, request parameters, response formats, and authentication mechanisms in YAML or JSON format (Tzavaras et al., 2023). It also includes the API version, terms of service, and contact information. It allows developers to build client libraries, documentation, and test suites automatically for their APIs. This improves consistency and decreases the time and effort necessary to design, test, and deploy APIs. Among the advantages of adopting OpenAPI are:

   It offers a standard method for describing APIs, making it simpler for developers, architects, and other stakeholders to discuss and comprehend API functionality. Utilizing OpenAPI, developers can automatically generate client libraries, documentation, and test suites, which reduces the time and effort required to create, test, and deploy APIs (Cao et al., 2017). OpenAPI allows APIs to be specified in a form that is simple for developers to comprehend and integrate, hence enhancing the overall user experience. OpenAPI is a widely established standard, which facilitates integration with other APIs and technologies. Swagger UI is among the many tools and platforms that enable OpenAPI. It is also used by several organizations and businesses, such as Google and Microsoft (Tzavaras et al., 2023). It offers a defined structure for outlining an API's user interface, complete with details on endpoints, parameters, answers, and data types. This can make it easier for developers to comprehend and make use of the API (GovStack, 2022a).

III. **OAuth 2.0:** A popular standard for authentication and authorization is OAuth 2.0. Authenticating and approving access to resources on behalf of a user enables programs to receive access tokens. OAuth 2.0 is an authorization system that allows third-party apps to access user resources without having the user provide credentials (Auth0, n.d.; Yang et al., 2017). OAuth 2.0 enables users to offer other apps access to their resources without providing those applications with direct access to their passwords or other sensitive data.

It is a safe and trustworthy method for users to provide other apps access to their resources. OAuth 2.0 eliminates the need for users to provide their usernames and passwords to third-party apps, therefore reducing the danger of password theft and unwanted access. Moreover, OAuth 2.0 enables users to choose whether resources are shared with third-party apps. Users may give or revoke access to specified resources at any time. This provides individuals with more control over their personal information and protects their privacy.

Several online and mobile apps accept OAuth 2.0, making it easy for developers to interface their applications with other services. Users may benefit from a more smooth and unified experience since this allows developers to create more powerful and integrated apps. OAuth 2.0 was created to handle a high number of users and apps. This makes it appropriate for usage in large-scale e-service contexts where several applications need safe and regulated access to user resources.

It is a widely established standard, thus when connecting with other services, developers can depend on a consistent and predictable API. This decreases the likelihood of mistakes and guarantees that programs operate in harmony. OAuth 2.0 is a crucial technology for the creation of e-services because it offers safe and regulated access to user resources, preserves user privacy, improves interoperability across applications, is scalable, and adheres to industry standards. So that we can conclude by saying it can aid in ensuring that sensitive information is safeguarded and that access to the e-Cabinet is secure.

IV. **JSON Web Tokens**: JSON Web Tokens (JWTs) are a mechanism for securely exchanging data between parties. They can be used as access tokens for authentication and authorization as well as to express claims about a person or application (Shovon et al., 2018). In other words, a JSON Web Token (JWT) is a typical sort of token-based authentication and authorization technique used in web applications. It is a concise, URL-safe method of describing transferred claims between parties. The token has three components: a header, a payload, and a signature.

The header specifies the type of token and the algorithm used to sign the token. The payload includes the claims, which are assertions about an entity (usually the user), as well as supplementary data. The claims can include information such as the ID, username, and role of the user. Combining the header and payload with a secret key and a cryptographic method generates the signature (Dalimunthe et al., 2022).

The server produces a JWT and transmits it to the client when a user logs in. The client then adds the JWT in subsequent requests to the server's Authorization header. The server can then utilize the information contained in the payload to authorize the user and allow access to resources after verifying the JWT's authenticity by examining the signature. JWTs have the benefit of being self-contained and may be utilized across many domains or services. This makes them a popular option for single sign-on (SSO) systems, in which a user may log in once and then access various apps or services without logging in again (Dalimunthe et al., 2022).

It is essential to highlight, however, that JWTs should be handled wisely and securely. The secret key used to sign the JWT must be kept secret and secure, and the payload must not include sensitive information that might be used to undermine security. It shouldn’t be stored in local or session storage, but in httpOnly cookies (Dalimunthe et al., 2022). Moreover, JWTs have a limited lifetime and must be frequently refreshed or updated to preserve security.

V. **API versioning**: API versioning is the process of giving an API a version number to keep track of changes over time. This can make it easier to maintain the functionality of apps created using the API even when the system is modified. In e-service development, API versioning is crucial because it enables developers to make changes to an API while keeping backward compatibility with existing client applications. This is crucial for a number of reasons:

It ensures consistency in its usage and accessibility. With a clear and consistent versioning policy, developers can ensure that clients continue to use the API in a predictable and dependable manner. APIs are frequently updated

to offer new capabilities, repair issues, and enhance performance. By versioning an API, developers can make modifications without affecting existing clients. This allows the API to adapt over time to changing business and user requirements. URI versioning is a common practice to do API versioning (Neumann et al., 2021). Neumann (2022), has also mentioned query-parameter versioning and header versioning as ways of API versioning.

Versioning an API can enhance interoperability among clients that use the same API. This is particularly significant in the development of e-services, since multiple clients may access the same API. By utilizing a consistent versioning technique, developers may ensure that clients can interface with the API in a consistent manner.

Ensuring backward compatibility with existing client programs is essential for a great user experience. By versioning an API, developers can make modifications without impacting the user experience of existing clients. This enables consumers to continue using their preferred programs uninterrupted. API Versioning can also improve security by allowing developers to resolve security flaws or other security problems without disrupting existing customers.

API versioning is a crucial aspect of e-service development since it enables developers to make modifications to an API while maintaining backward compatibility with current client applications. This enhances uniformity, adaptability, interoperability, user experience, and security.

Overall, API standards can aid in ensuring the interoperability, security, and dependability of an e-Cabinet. Developers can create apps that interface with the system more quickly and effectively by adhering to standardized API standards, which will eventually enhance user experience and boost productivity.

4.1.2 Public Key Infrastructure (PKI)

The Public Key Infrastructure (PKI) refers to a collection of methodologies, regulations, and systems that facilitate secure electronic transactions and communications. The

utilization of Public Key Infrastructure (PKI) is imperative in the development of e-Cabinet systems as it guarantees secure communication, authentication, and data encryption. In the development of e-Cabinets, PKI adheres to customary procedures that involve the utilization of digital certificates also known as Certificate Authority (CA) to verify the legitimacy of users and devices, the incorporation of a certificate revocation mechanism to regulate compromised certificates, and the utilization of encryption technologies to safeguard data transmission. Public Key Infrastructure (PKI) is utilized to establish secure email communications, encrypt sensitive documents, and authenticate user identities during system login. The e-Cabinet system employs digital certificates to facilitate secure communication between its users and the system. The system should employ X.509 digital certificates that comprise a public key and are granted by a reliable Certificate Authority (CA) (Myers et al., 1999). The certificates serve the purpose of authentication and encryption, thereby guaranteeing that the system's data can only be accessed and modified by authorized users. Furthermore, digital signatures can serve as a means of validating the legitimacy of electronically signed communications and records, thereby offering a mechanism for ensuring that they remained unaltered during transit. In the context of e-Cabinet development, PKI is an essential element that plays a crucial role in safeguarding the confidentiality, integrity, and availability of sensitive data.

4.1.3 Lightweight Directory Access Protocol

The e-Cabinet system utilizes the Lightweight Directory Access Protocol (LDAP) as a means of accessing and managing its directory information (Koutsonikola & Vakali, 2004). The Lightweight Directory Access Protocol (LDAP) is a protocol utilized in a client-server architecture that enables clients to retrieve and manipulate directory information that is stored on a server (Wang et al., 2008).

The e-Cabinet system employs LDAP for user authentication and authorization (Koutsonikola & Vakali, 2004; Wang et al., 2008). The system upholds a registry of users and their corresponding access authorizations, with LDAP serving as the means of administering this registry. Upon logging into the e-Cabinet system, the user's credentials undergo validation through the LDAP protocol, and their access privileges should be subsequently verified against the directory.

LDAP is utilized for the management of both users and groups. The e-Cabinet system has the capability to utilize LDAP for the purpose of importing users and groups from external directory services, such as Microsoft Active Directory or OpenLDAP (Koutsonikola & Vakali, 2004). The utilization of existing user directories enables the system to optimize its functionality and streamline the process of user administration.

The e-Cabinet system can rely heavily on LDAP as a centralized directory service for managing user authentication, authorization, and management.

4.1.4 ISO Standards

The International Organization for Standardization (ISO) has formulated various standards of document management systems, encompassing electronic document management systems and e-Cabinet. The following ISO standards should be pertinent to e-Cabinet:

I. **ISO 15489:** ISO 15489 offers a set of recommendations for the effective management of records within an organizational context, encompassing both physical and digital records (Healy, 2010). The scope of this record management system encompasses the entirety of the records' life cycle, commencing from their inception and concluding with their disposal.

II. **ISO 19005 (PDF/A):** This standard delineates the prerequisites for the enduring conservation of electronic documents in PDF format (S. J. Sullivan, 2006). The preservation of PDF documents guarantees their precise and dependable reproduction in the future, notwithstanding technological advancements.

III. **ISO 27001:** This standard offers a comprehensive structure for the implementation and maintenance of information security management systems (ISMS) (Hsu et al., 2016). This outlines the necessary criteria for the establishment, implementation, maintenance, and ongoing enhancement of information security management systems aimed at safeguarding information assets.

IV. **ISO 32000:** This standard outlines the necessary specifications for generating, displaying, and reproducing PDF files (Devine et al., 2011). The

standardization of PDF documents guarantees their compatibility and exchangeability among various platforms and devices.

V. **ISO 16175:** This standard, also known as OAIS, offers guidance on the creation and upkeep of digital repositories (Deng et al., 2019). The comprehensive scope of this digital information management process encompasses all stages of its life cycle, ranging from the initial acquisition and storage to its long-term maintenance, retrieval, and distribution.

The implementation of standardized and secure measures in the design, implementation, and maintenance of the e-Cabinet system is crucial in enhancing its reliability, interoperability, and usability.

4.1.5 Database Standardization

The implementation of database standards ensures the safeguarding of data within the e-Cabinet system. The intricate e-Cabinet system is responsible for the management of sensitive and classified information. The database of the system is required to meet rigorous standards for data security, integrity, and availability. The implementation of database standards ensures that the database of the e-Cabinet system is designed, constructed, and managed in accordance with optimal methodologies, thereby reducing the likelihood of data breaches and ensuring the availability of data. The establishment and adherence to database standards are imperative for ensuring the security and proper operation of the e-Cabinet system. The e-Cabinet system is subject to various technical standards pertaining to database recovery and backup, security, and performance. These standards include:

I. **ACID:** ACID, which stands for Atomicity, Consistency, Isolation, and Durability, is a collection of characteristics that guarantee the dependable processing of database transactions (Little, 2003). The concept of atomicity in database management refers to the property of transactions being regarded as indivisible units of work that are either executed in their entirety or not at all, ensuring that they are treated as a cohesive whole. In the realm of databases, consistency refers to the property wherein transactions are responsible for

transitioning the database from a valid state to another valid state. The concept of isolation refers to the independent processing of transactions, while durability pertains to the permanent nature of a committed transaction.

II. **RAID:** RAID, which stands for Redundant Array of Independent Disks, is a technology used for data storage virtualization. It involves the integration of several physical disk drives into one or more logical units, intending to achieve data redundancy, performance enhancement, or both (Hughes et al., 2004; Rahman, 2017).

III. **Backup and Recovery:** The concept of backup and recovery pertains to the systematic procedure of generating and preserving duplicates of information to mitigate the risk of losing or impairing the primary data. This procedure encompasses periodic backups and restoration protocols and may entail varying degrees of data retrieval contingent upon the extent of the loss or impairment.

4.2 Hardware Architecture

The necessary hardware components for an e-Cabinet system can vary based on specific requirements. Nevertheless, servers, network infrastructure, computers, scanners, and storage devices are common hardware components that are typically required.

Servers are a crucial component of an e-Cabinet system because they host the software applications necessary for the system to function. Network infrastructure, such as routers and switches, is also essential because it facilitates communication between the system's numerous components.

Computers are typically used by users to access and interact with the e-Cabinet system; therefore, they must satisfy certain hardware requirements, including processing speed, memory, and storage space. A key feature of an e-Cabinet system is the digitization of documents, which is accomplished through the use of scanners.

Finally, storage devices such as hard drives, solid-state drives, or cloud storage are essential for storing and administering the enormous quantities of data and documents

generated and stored by an e-Cabinet system. To ensure that the system can continue to operate effectively and efficiently over time, sufficient storage space is required.

For the server, since it will be handling heavy workloads with a large number of documents and multiple processes simultaneously, it is a better idea to have multiple cores with at least 8 cores. The storage should also be four of 1 Terabyte of enterprise-class SATA hard drives. The choice between HDDs and SSDs for server storage depends on the specific workload and budget. HDDs may be preferable if the server is used for file storage or archiving, where data is accessed infrequently and storage space is a priority. HDDs have a larger storage capacity than SSDs, making them a superior option for large quantities of data. This is crucial for archiving purposes where data must be stored for extended periods of time. HDDs are generally less expensive than SSDs, making them a cost-effective solution for businesses that need to store large quantities of data (Yamato, 2015, 2016). Since data access speed is less of an issue in archival storage, the sluggish read and write capabilities of HDDs are less of a disadvantage. HDDs have been used to store data for many years, and they have a track record of dependability and durability (Yamato, 2016). This is essential for long-term data storage, where the integrity of the data is crucial.

Based on the workshop to integrate Amphora DMS, the user's computers must have a stable internet connection. The preferred internet speed should be at least 20 Mbps. The operating system is preferred to be Windows 10. Though Amphora works with other operating systems such as Linux or MacOS, some features might work with limited functionalities. As for the display, the preferred resolution recommended for the users is at least 1280 X 1024 pixels.

It is recommended to use Redundant Array of Independent Disks (RAID) technology to combine multiple physical disk drives into one or more logical units. It is utilized primarily for data redundancy, performance enhancement, or both. In a RAID configuration, data is distributed across the drives in various ways, referred to as RAID levels, which determine the system's advantages and disadvantages. Either hardware, such as a RAID controller device, or software, where the operating system manages the RAID array, can be used to implement RAID (Hughes et al., 2004; Lear et al., 1996). RAID 10 can be implemented because it can facilitate an e-Cabinet system with multiple purposes. As it incorporates both disk replication and disk striping, it provides a high

level of fault tolerance (Rahman, 2017). This allows for rapid and efficient data access as well as protection against data loss in the event of a disk failure, as data is replicated and distributed across multiple disks. Since data is striped across multiple disks, concurrent read and write operations are possible, enhancing the system's overall performance and responsiveness. In an e-Cabinet system that processes and accesses large quantities of data, RAID 10 can help ensure that the system functions seamlessly and reliably, with minimal risk of data loss or delay caused by disk failures.

4.3 Software Architectures

As discussed earlier, the architecture for the e-Cabinet can be based on two architectures, which are Layered Architecture and Microservices Architecture. In a layered architecture approach, the system is divided into layers, with each layer responsible for a distinct set of capabilities. The layers are organized hierarchically, and layer-to-layer communication adheres to a strict protocol. The layered architecture permits the separation of concerns and modular development (March & Hevner, 2007; Zhang & Goddard, 2007). On the other hand, microservices architecture allows each service to be developed, deployed, and scaled independently. This method enables flexibility and maintenance simplicity.

4.3.1 Layered Architecture

In order to effectively organize, interoperate, and comprehend the data and pertinent technologies within a decision support system, the software architecture should be composed of six layers from a hierarchical architectural perspective (Goddard et al., 2022; Zhang & Goddard, 2007). The layers consist of the Presentation layer, Application Layer, Data Access Layer, Database, Security Layer, and Integration Layer. It is based on the mapped building blocks required for the e-Cabinet system from Table 1. Again, based on the microservices architecture, the e-Cabinet system would comprise several independent services or modules, each with its unique functionality. These services would communicate with one another via APIs to form a unified and cohesive system. The layers for the e-Cabinet system should include the presentation layer, application layer, data access layer, database layer, security layer, and integration layer.

I. **Presentation Layer:** The e-Cabinet system's presentation layer ought to furnish a user-friendly, responsive, and intuitive interface to enable cabinet members to access the system and execute their functions. The software solution can manifest as a web-based application, a mobile-based application, or a desktop-based application. The subsequent elements hold significance for the presentation layer. In addition, the software ought to incorporate features such as text-to-speech and screen interpreters, while also adhering to accessibility guidelines such as WCAG 2.1 (Paul, 2022). Overall, the presentation layer of an e-Cabinet system should be designed to provide cabinet members with a seamless experience, making it simple for them to access and use the system to carry out their duties effectively.

II. **Application Layer:** The e-Cabinet system's application layer is responsible for the execution of the system's business logic. It has modules for administrating agendas, uploading and managing documents, scheduling meetings, and documenting decisions. The optimal design for the e-cabinet system would entail a set of discrete modules that are only loosely connected, with each module being assigned a specific function. In addition, the system must possess the capability to handle increasing amounts of data and users while maintaining optimal performance, as well as automate repetitive tasks and processes, including scheduling meetings, sending notifications, and generating reports.

III. **Data Access Layer:** The data access layer is responsible for interacting with the database and providing data to the application layer in an e-Cabinet system. It comprises modules for database querying, updating, and managing. With security in mind, the data access layer should be designed. To protect against SQL injection attacks, it should include data encryption, role-based access control, and parameterized queries. Moreover, using techniques like sharding, partitioning, and load balancing is a key aspect of the data access layer (Kim et al., 2016)**.** The data access layer of an e-Cabinet system should be designed to provide efficient, secure, and scalable database access. It should be decoupled from the application layer to facilitate future system modifications and improvements. Additionally, it should be designed to integrate with other systems and applications, allowing for seamless data exchange.

IV. **Database:** The optimal design of the database for an e-Cabinet system should encompass the capacity to effectively store and manage the data that is essential for the system's operation. A relational database can be utilized to guarantee the consistency and integrity of data. Furthermore, the database must incorporate contingency plans for data backup and recovery to guarantee the restoration of information in the occurrence of a system malfunction or any other unforeseen calamity. The optimal design of an e-Cabinet system's database should prioritize the provision of effective, protected, and adaptable data storage and administration. The system ought to be devised in a manner that can effectively handle substantial quantities of data and users, while also ensuring that its performance and data integrity are optimized.

V. **Security Layer:** The e-Cabinet system's security layer is accountable for ensuring the confidentiality, integrity, and availability of both the system and its data. The implementation of a security layer must incorporate authentication mechanisms to guarantee that solely authorized users can gain entry into the system. Such mechanisms may include the use of passwords, two-factor authentication, or biometric authentication. An authorization mechanism may be implemented through the utilization of role-based and attribute-based access control. The implementation of security measures in a system can involve the utilization of SSL/TLS, HTTPS, and data encryption as a means to establish a secure layer. The security layer ought to incorporate mechanisms that enable the identification and resolution of prospective security vulnerabilities. The aforementioned objectives can be achieved via the implementation of methodologies such as penetration testing, vulnerability monitoring, and patch management (Cavusoglu et al., 2008). Moreover, the security layer should include auditing and logging mechanisms to monitor user activity and identify potential security violations.

VI. **Integration Layer:** The e-Cabinet system's integration layer facilitates the connection between the system and various other systems and applications. The incorporation layer ought to comprise APIs (Application Programming Interfaces) that facilitate the interaction between the e-cabinet system and other systems and applications. The feasibility of achieving this objective can be realized by leveraging REST APIs and SOAP APIs. The proposed system ought to incorporate message queuing mechanisms that facilitate asynchronous inter-

system communication through the utilization of techniques such as RabbitMQ and Apache Kafka (Chamoso et al., 2018). The integration layer must have the capability to accommodate diverse data exchange formats, including but not limited to XML, JSON, and CSV. Furthermore, it is noteworthy that the integration layer has the potential to encompass middleware components, such as Enterprise Service Buses (ESBs), which can furnish supplementary capabilities such as message routing and protocol conversion.

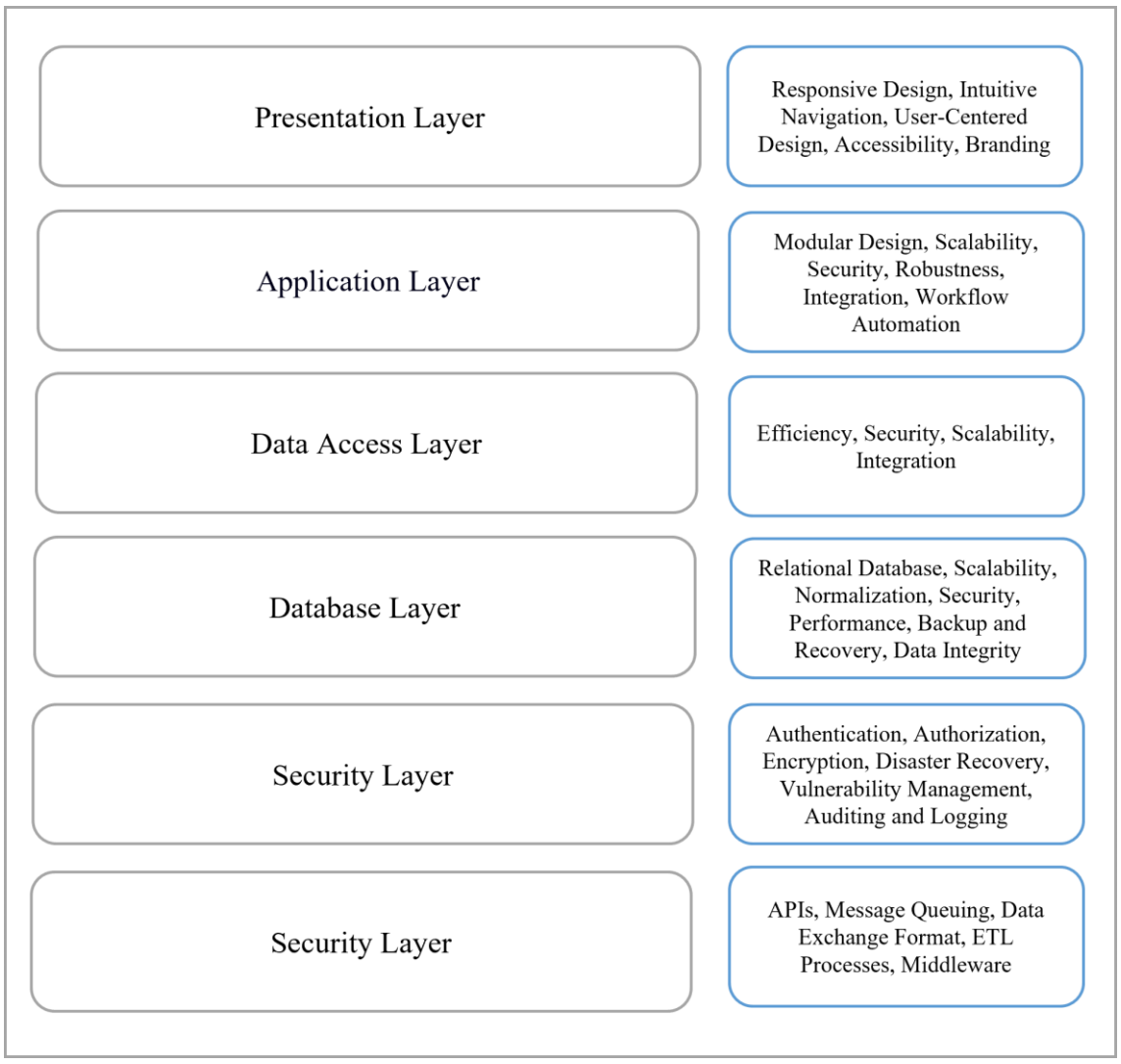

Figure 2: Layered Architecture

4.3.2 Microservices Architecture

Microservices architecture is a more advantageous alternative for intricate and swiftly changing applications due to its heightened flexibility, scalability, resilience, and agility.

Nevertheless, it entails a distinct array of challenges, such as heightened intricacy and expenses related to operations. Within the context of microservices architecture, the impact of a single microservice's failure is limited to that specific microservice and does not extend to the overall application. The residual components of the application can sustain regular functionality. This enhances the system's resilience against potential failures. Teams have the ability to work autonomously on their respective microservices, utilizing diverse programming languages and frameworks. Furthermore, they can implement updates and modifications without impacting the entirety of the application. The scaling of microservices can be adjusted according to the workload, leading to enhanced resource efficiency and cost-effectiveness. The microservices architecture enables autonomous maintenance and updates of individual microservices, without causing any impact on other components of the system. Simplification and risk mitigation are facilitated by this approach toward updates and maintenance. The e-Cabinet services ought to comprise User Management, Document Management, Workflow Management, Audit, Communication, Search, and Integration.

I. **User Management Service:** This microservice in question holds significant importance as a fundamental element within the microservices architecture of an e-Cabinet system. In general, the system would be accountable for overseeing user registration, authentication, authorization, and profile management. The registration process for the e-cabinet system would be facilitated by the microservice, which would require users to furnish their name, email address, and password. The authentication of users would be conducted through the utilization of widely recognized industry-standard mechanisms such as OAuth, OpenID Connect, or JSON Web Tokens (JWT). The management of user access could be achieved through the implementation of either role-based access control (RBAC) or attribute-based access control (ABAC) methodologies. Furthermore, this particular service would afford its users the capability to oversee their profile data, encompassing their name, email, phone number, and address. Additionally, it would document user engagement, such as login endeavors, unsuccessful login attempts, and other actions, to supervise and track user conduct for security and audit objectives.

II. **Document Management Service:** The microservice responsible for managing documents is a pivotal element within the microservices framework of an e-

Cabinet system. In general, its responsibilities would encompass the storage, retrieval, and control of document versions. The proposed microservice is designed to facilitate document storage within a database or document repository. It includes a search function that allows users to retrieve documents based on various criteria, such as keywords and metadata. In addition, this particular service must offer version control capabilities to effectively handle numerous iterations of documents. Additionally, it should regulate document accessibility through the implementation of access control mechanisms, such as Role-Based Access Control (RBAC) or Attribute-Based Access Control (ABAC).

III. **Workflow Management Service:** The provision of this service is crucial for the management of workflow creation, execution, and monitoring within an e-Cabinet system. The system comprises various functionalities such as defining workflows, utilizing templates, managing tasks, escalating and reminding, sending notifications and messages, analyzing workflows, and integrating with document management. The service for managing workflows enables regulated and effective document workflows within the e-Cabinet system, optimizing procedures, fostering cooperation, and guaranteeing adherence to organizational policies.

IV. **Audit Service:** The audit service is accountable for the documentation and monitoring of all activities associated with the e-Cabinet system to guarantee security, compliance, and visibility. The aforementioned components comprise audit recording, audit trace, audit reports, security monitoring, compliance management, user management integration, and workflow management integration. The audit service facilitates the secure, compliant, and transparent utilization of the e-Cabinet system by empowering system administrators to oversee system usage, detect security breaches, and scrutinize system irregularities.

V. **Search Service:** The search function of the e-Cabinet system facilitates swift document and content retrieval for its users. The service offers a comprehensive search functionality that encompasses both full-text and metadata search capabilities. Additionally, it provides users with advanced search options, the ability to preview and rank search results, and various navigation options to

facilitate ease of use. The integration of the system with the document management microservice guarantees the searchability of all documents, while its integration with the security and access control microservice ensures that document searches are conducted solely by authorized users. The objective of the search service is to enhance efficiency and cooperation by facilitating users in locating the necessary content with ease.

VI. **Integration Service:** The integration service enables data exchange and provides features such as data mapping, API management, event triggering and notification, integration with document and workflow management, and data synchronization to facilitate the integration of the e-Cabinet system with external systems and services. These capabilities ensure that the e-Cabinet system is compatible with external systems and that data sharing across all systems is seamless and consistent.

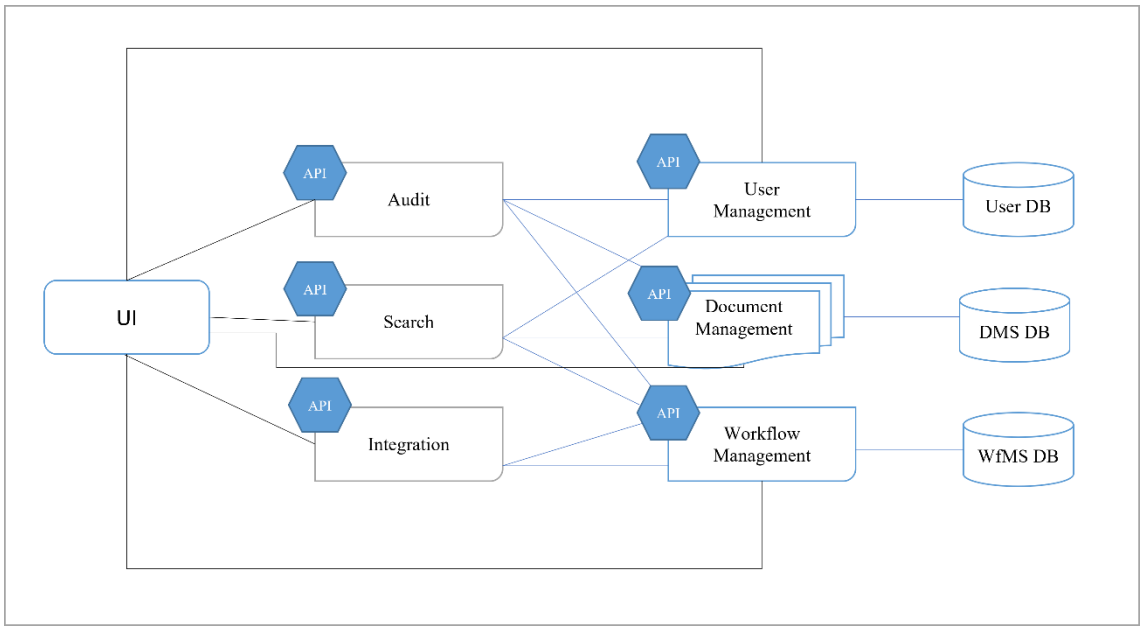

Figure 3: Microservices Architecture

5 Interview

The research study selected two interviewees based on their valuable knowledge and experience in the development of building blocks for the e-Cabinet system. The two

parties are engaged in collaboration with GovStack, an entity tasked with the development of the technical and architectural elements necessary for the e-Cabinet platform. The information obtained from the interviewees yielded a comprehensive comprehension of the technical and architectural components of the e-Cabinet system, as well as the critical role played by the building blocks in its development.

The research process presented a challenge in identifying interviewees who possessed experience working with both the GovStack and e-Cabinet systems. Two participants were identified and chosen for the interviews on the basis of their technical expertise and experience, which are essential for the development of the e-Cabinet system. The two individuals who were interviewed offered significant perspectives on the building blocks of the system and the aspects that are linked to their creation. Notwithstanding the restricted sample size of the interviewees, the data collected from these interviews were found to be valuable in comprehending the technical and architectural aspects and identifying the building blocks of the e-Cabinet system.

The study employed a purposeful sampling methodology to select specific individuals or settings that would yield ample information (Coyne, 1997). The emphasis was placed on obtaining high-quality data and participants who were rich in information.

6 Research Outcome and Main Results

6.1 Findings

The findings are a list of identified codes that can be considered as the essential build blocks of an e-Cabinet system with important aspects. Based on the two interviewees, each code connected to the interviews is presented in table 2. However, for better understanding the codes Digital Registry, Registration, Workflow Engine, CMS, DMS, and Notification System will be described as essential building blocks.

Table 2: Codes Ordered by Number of Occurrences and Respondents.

No.	Code	Occurrences	Respondents
1	Meet Requirements	13	2
2	Flexible & Agile	12	2
3	Sandbox	6	2
4	Context Analysis	6	2
5	Registration	4	2
6	Digital Registry	4	2
7	Workflow Engine	3	2
8	DMS	2	2
9	CMS	2	2
10	Notification System	2	2
11	Microservices and Layered Architecture	2	1

6.1.1 Meet Requirements

The results showed that interviewees considered meeting requirements to be one of the most important parts of GovStack BB adaptation with thirteen occurrences by both interviewees. From analyzing the responses that any country to adapt build blocks of GovStack must have:

- Proper infrastructure.
- Motive of changing.

This means having both operational and technical requirements matched. One of the respondents responded positively about challenges in operational and technical aspects answering interview question four by saying:

"It's a healthy mix of both of them actually."

In order to guarantee that the system complies with any applicable laws or standards, requirements must be met. The risk of expensive rework or legal issues, later on, may be decreased by recognizing the requirements up front and designing and developing with compliance in mind.

6.1.2 Flexible & Agile

The attainment of flexibility can be facilitated through the implementation of a modular and extensible system design, wherein the utilization of Application Programming Interfaces (APIs) serves to establish connections between various system components. It occurred twelve times for both of the interviewees. The implementation of an agile methodology enables the development team to promptly adjust to evolving requirements and effectively address feedback from end-users. The implementation of continuous integration and deployment methodologies facilitates expeditiously testing and implementing modifications to the system, thereby diminishing the duration required to introduce new features or fix errors. Responding positively to the question about agility and flexibility one of the respondents said:

"I think it is very much doable."

Finally, it can be said that the adaptation of GovStack building blocks is characterized by flexibility and agility in the context of an e-Cabinet system. This approach involves the development of a modular and extensible system that utilizes APIs to connect various components, while also adopting agile development practices.

6.1.3 Sandbox

The GovStack sandbox offers a protected and isolated environment for governmental organizations to explore and evaluate novel digital services and solutions. There was no specific question about it, however, the sandbox has occurred six times coming from both

respondents. This conveys the concept of system development through the utilization of requirements and background analysis. In the event that a specific country exhibits a preference for the sandbox-designed and developed system, they may proceed accordingly. An interviewee said:

> *"So, sandbox is kind of like a kitchen so you can cook whatever you want and see if this actually suits you or not, and based on that you can move forward."*

Finally, it can be said that the utilization of a sandbox is of great significance as it furnishes a secure and segregated milieu for conducting experiments and trials of novel digital amenities, thereby mitigating the likelihood of adverse repercussions on operational systems.

6.1.4 Context Analysis

Both interviewees stated the importance of context analysis six times. Prior to the implementation of GovStack building blocks for an e-Cabinet system, it is crucial to conduct an assessment of the project's environment to identify its specific requirements, constraints, and opportunities. This approach ensures that the building blocks are tailored to meet the distinct needs of the stakeholders and effectively achieve the objectives that are set. A respondent stated:

> *"So, it is absolutely vital to do your homework before you go about defining what building blocks are required."*

Another statement was:

> *"We need to understand, let's say what tools we have at our disposal, what sort of capabilities exist within the system itself."*

6.1.5 Essential Building Blocks

The point of convergence between the two respondents was the identification of the fundamental building blocks that are indispensable for the development of an e-Cabinet system. The essential BBs are Digital Registries, Registration, CMS, DMS, Workflow Engine, and Notification systems which have occurred a total of seventeen times.

The implementation of digital registries offers a centralized repository for the purpose of managing Cabinet data and information, thereby ensuring its accuracy, currency, and accessibility.

The registration process facilitates the secure and efficient access of the Cabinet system by authorized Cabinet members, thereby mitigating the risk of unauthorized access and enhancing the security of data.

The CMS (Content Management System) offers a digital platform for the management of Cabinet-related content, with the aim of ensuring its organization, searchability, and user-friendly presentation.

The Document Management System (DMS) facilitates effective and protected administration of digital documents pertaining to Cabinet matters, thereby minimizing reliance on paper-based procedures and enhancing the accessibility of information.

The Workflow Engine facilitates the automation and orchestration of operations related to Cabinet, thereby diminishing the need for manual intervention and enhancing the efficiency and consistency of the processes.

The Notification System facilitates precise and prompt correspondence with members of the Cabinet, guaranteeing that they are apprised of significant developments and occurrences pertaining to the Cabinet framework.

6.1.6 Microservices and Layered Architecture

The e-Cabinet system's microservice architecture entails the creation of a system comprising discrete, autonomous services that collaborate to deliver the necessary functionality, with each service dedicated to a particular function.

The layered architecture is characterized by the systematic arrangement of the system into discrete layers, each of which is responsible for a particular task, such as presentation, application logic, and data storage. The layers are interconnected through clearly defined interfaces, enabling communication between adjacent layers. Both microservice and layered architectures can provide advantages such as scalability, modularity, and flexibility. These architectures have occurred twice by one interviewee.

6.2 Identified Building Blocks

Throughout the research process of an e-Cabinet system, several scholarly articles pertaining to the constituent components and features of the said system were examined, alongside an analysis of Nextsense, an enterprise that specializes in the optimization of organizational efficiency through digital transformation processes and ICT solutions. An e-Cabinet solution with multiple functionalities has been developed by Nextsense. An investigation was conducted on the correlation between e-parliament and e-Cabinet systems. The workshops centered on the adoption of the e-Cabinet system in Djibouti, offering valuable insights into its relevant functionalities and identifying several fundamental building blocks. Subsequently, a cartographic representation of these fundamental units was generated. The building blocks that have been mapped are presented below:

Table 3: Identified Building Blocks (BB)

Source / **Building Blocks**	**e-Parliament**	**Nextsense**	**Djibouti Workshop on e-Cabinet**	**Interview**
Digital Registry				✓
Registration				✓
Notification		✓	✓	✓
Content Management System	✓	✓		✓
Digital Identity	✓	✓	✓	
Information Management System	✓			
Document Management System	✓	✓	✓	✓
Interoperability	✓	✓	✓	
e-Signature		✓	✓	

Security	✓	✓	✓	✓
Workflow Management System	✓	✓	✓	✓
Collaboration Tools	✓	✓	✓	

6.3 Proposed Architecture

Based on the common functionalities of layered and microservices architecture, a mapped table can provide better insight:

Table 4: Mapped Functionalities of Different Architectures

Common Functionalities	**Layer**	**Microservices**
The user interface, interaction with end-users	Presentation	
Business logic, handling of specific functions	Application	Document management, User management, Search, Notifications
Data persistence, access, and retrieval	Data Access	
Data Storage	Database	
Authentication, authorization, and access control	Security	Authentication, Authorization
Handling of crosscutting concerns	Integration	Logging, Monitoring

Following the mapping of both architectures, a hybrid architecture of the e-Cabinet system can be proposed. The e-Cabinet system's hybrid architecture incorporates the principles of microservices and layered architecture to create a scalable, flexible, and maintainable system. It enables the efficient management of particular system functions via micro-services and provides the structure and organization of layered architecture for the domain and data layers.

I. **Presentation Layer:** In a hybrid e-Cabinet architecture, the presentation layer is typically a web application or a mobile application that provides a user interface

for interacting with the system. The presentation layer would render the user interface and process user inputs. It would also communicate with the application layer via RESTful Interfaces to retrieve data and execute system operations.

The presentation layer must be designed to be intuitive, user-friendly, and responsive. It must offer a uniform user experience across multiple devices and platforms. The user interface should be designed with the requirements and preferences of the intended audience in mind.

To ensure the system's scalability and performance, the presentation layer should be designed using modern web development frameworks and technologies. Additionally, it should be able to accommodate a large number of concurrent users and requests. To restrict access to sensitive information, the presentation layer should be secure, and user authentication and authorization should be implemented.

II. **Application Layer:** The application layer of the e-Cabinet system would be comprised of multiple microservices that manage numerous components of the system's business logic, including document management, user management, search, and notifications.

Each microservice in the application layer would be accountable for a particular function or feature of the e-Cabinet system and would communicate with other microservices and the presentation layer via well-defined interfaces, typically REST APIs. For instance, the user management microservice would be responsible for user authentication, authorization, and profile management, whereas the document management microservice would be in charge of publishing, storing, retrieving, and managing documents in the system.

The microservices of the application layer would be designed to be loosely coupled and independently deployable, making the e-Cabinet system simpler to maintain, update, and scale.

III. **Domain Layer:** The domain layer is responsible for modeling the e-Cabinet system's entities and rules. It specifies the business entities and incorporates the business logic governing their behavior. The domain layer is implemented with a

layered architecture and a domain model that represents business entities and associated business principles.

The domain model specifies the organization and manipulation of the system's data. It is comprised of classes, interfaces, and enumerations that represent business entities and their relationships. The domain layer also specifies the business rules that regulate the creation, modification, and deletion of entities.

In an e-Cabinet system, for instance, the domain model may include classes such as "Document", "User", "Folder", and "Tag", which represent the various categories of system entities. The domain model would also include the business rules that regulate how these entities are created, modified, and deleted, such as document versioning rules or folder permissions.

By isolating the domain layer from the other layers, the e-Cabinet system can ensure that the business logic is decoupled from the technical infrastructure and can be updated easily without disrupting the rest of the system.

IV. **Infrastructure Layer:** The infrastructure layer assumes the responsibility of furnishing technical assistance to the e-Cabinet system by means of diverse microservices, such as authentication, authorization, logging, monitoring, and notification services. The microservices in question are responsible for ensuring the security, efficiency, and overall health of the system. The e-Cabinet system's proper functioning is heavily reliant on the infrastructure layer, which can be developed with considerations for scalability, flexibility, and maintainability.

V. **Data Layer:** In the e-Cabinet system, the data layer is responsible for administering the persistence of the data. This layer is implemented with a layered architecture that includes a data access layer that abstracts the underlying database. The data access layer is responsible for administering database interactions, such as data queries and updates.

The data layer is intended to facilitate the storage and retrieval of a vast array of document types and metadata. It must be able to manage large amounts of data and provide quick and dependable access to those data. The data layer may employ relational databases, NoSQL databases, or a combination of the two.

The data layer must also guarantee the data's security and integrity. This includes instituting appropriate access controls and authentication mechanisms as well as backup and recovery procedures in the event of data corruption or loss. In addition, the data layer must comply with any applicable data privacy and protection regulations, such as the General Data Protection Regulation (GDPR) and the Health Insurance Portability and Accountability Act (HIPAA).

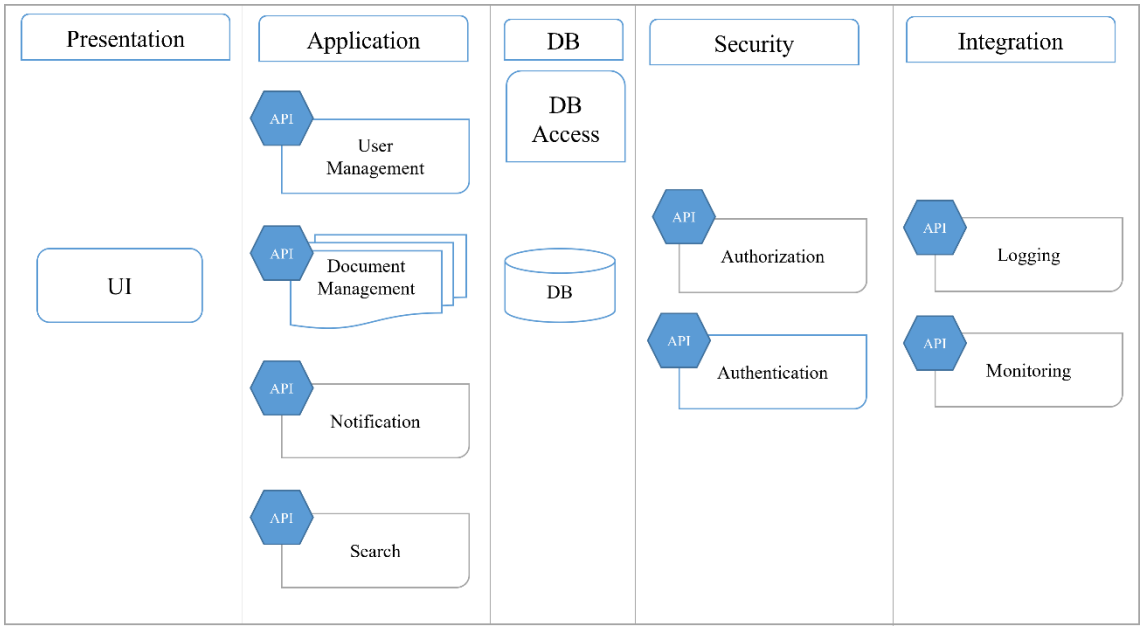

Figure 4: Hybrid Architecture

Here is a table that maps the common functionalities of the layers and services in an e-Cabinet system's hybrid architecture:

Table 5: Mapped Functionalities of Hybrid Architecture

Common Functionality	**Presentation Layer**	**Application Layer**	**Domain Layer**	**Infrastructure Layer**	**Data Layer**
Authentication	✓	✓		✓	✓
Authorization		✓		✓	✓
User Management		✓	✓	✓	✓
Document Management		✓	✓	✓	✓

Workflow Management		✓	✓	✓	✓
Audit Trail		✓	✓	✓	✓
Search		✓	✓	✓	✓
Integration	✓	✓	✓	✓	✓
Logging				✓	✓
Monitoring				✓	✓

The entries in this table represent the common functionalities shared by the various layers and services. A checkbox (✓) signifies that the layer or service supports the specified functionality.

For instance, the Infrastructure Layer and Data Layer both provide authentication and authorization functionality, as they are responsible for administering user access and permissions. Similarly, both the Application Layer and microservices such as User Management Service provide user management functionality, as they are responsible for the creation, deletion, and modification of user accounts.

7 Limitations

Notwithstanding the valuable insights provided by this dissertation, it is imperative to recognize the possible constraints that could affect the veracity and applicability of the results.

Initially, it should be noted that the study employed a limited sample size, comprising solely two interviewees. Although the interviewees exhibited robust technical expertise and provided broad and profound perspectives, the restricted sample size could potentially constrain the applicability of the findings to a more extensive populace.

The study's research methodology was constrained to a thematic analysis of qualitative data, which may not comprehensively encompass the intricacies and intricacies of the subject matter.

In spite of these limitations, the findings of this thesis provide valuable insights into the adaptation of GovStack building blocks for the development of an e-Cabinet system and serve as a foundation for future research in this area.

8 Discussion

8.1 Building Blocks of e-Cabinet

The essential and every other GovStack building block needed for the development of an e-Cabinet system are mainly dependent on two factors. Firstly, it depends on the individual county's context. It is crucial to comprehend that every country possesses a distinct contextual structure, and the adaptation of GovStack components will correspondingly differ. The successful adoption of these building blocks is contingent upon the critical factor of having the necessary infrastructure and resources to support their implementation. When making decisions about which building blocks to prioritize and adapt, governments should take into account their unique context, infrastructure, and resources. Acknowledging the variability in the implementation of GovStack building blocks is crucial, and it is imperative to recognize that a universal approach may not be suitable for all nations. Undertaking a contextual analysis is of crucial importance in ascertaining the particular demands and prerequisites of a country, and in pinpointing the essential building blocks that ought to be given priority for adaptation. The analysis of context offers insights into the prevailing infrastructure, resources, and governance frameworks of a country, all of which are crucial considerations prior to the implementation of GovStack building components. Through the implementation of a thorough contextual analysis, governmental bodies can arrive at well-informed determinations regarding the prioritization of building blocks and the most effective means of adapting them to suit their particular requirements. Consequently, conducting a thorough analysis of the context is an essential prerequisite for the effective implementation and adoption of GovStack's foundational building blocks in the development of an e-Cabinet system.

However, according to the experts, the essential building blocks required for the development of an e-Cabinet system are the digital registry, registration, workflow engine, CMS, DMS, and notification system. There can be other BBs such as collaboration tools and digital signatures for better efficacy, as presented in Table 3. The utilization of these essential BBs serves as a basis for the execution of digital governance methodologies, thereby facilitating governmental enhancement of efficiency, transparency, and responsibility within their operations. The fundamental components of

an e-Cabinet system may exhibit variations in their implementation, contingent upon the contextual and regulatory demands of the respective nation. Nonetheless, these BBs constitute a crucial groundwork for the establishment of an e-Cabinet system. Hence, it is imperative for governments to accord priority to these fundamental BBs while adapting GovStack building blocks to guarantee the effective implementation of an e-Cabinet framework.

8.2 e-Cabinet Architecture

In regards to the architecture of an e-Cabinet system, both microservices and layered architecture possess their respective advantages and disadvantages. The microservices architecture presents advantages such as flexibility, scalability, and the capacity to deploy autonomous services (Hasselbring & Steinacker, 2017; Puspitasari et al., 2021). Conversely, the layered architecture provides a more organized approach to the development process, which facilitates the maintenance and testing of the system (Goddard et al., 2022; Zhang & Goddard, 2007). Therefore, as an optimal solution for the creation of an e-Cabinet system, it would be a hybrid architecture that amalgamates the advantages of both methodologies. The proposed architecture would provide the advantages of microservices in terms of flexibility, adaptability, and expandability, while simultaneously implementing a systematic approach to the software development lifecycle, guaranteeing that the system is sustainable, verifiable, and expandable. Observing the functionalities of the building blocks for an e-Cabinet system's development would benefit from a hybrid architecture that integrates the most advantageous aspects of both architectures, as presented in Table 4.

However, it is important to keep in mind that the proposed hybrid architecture must satisfy the prerequisites of GovStack's building blocks. Although both microservices and layered architecture have their respective advantages, it is imperative to verify that the architecture aligns with the fundamental components and does not jeopardize the system's overall functionality. Consequently, it is imperative to ensure that the hybrid architecture is formulated in a manner that is consistent with the GovStack foundational components and can be effortlessly incorporated into them. Through this approach, the e-Cabinet system can effectively leverage the advantages offered by both methodologies, while also satisfying the prerequisites of GovStack building blocks.

8.3 Standard Practices

Apart from the fundamental components and the amalgamated structure, it is imperative to uphold standard practices such as REST API standardization, OpenAPI, and JWT implementation. The implementation of measures to guarantee interoperability, security, and adherence to industry best practices is imperative for the optimal functioning of the e-Cabinet system. Furthermore, the implementation of diverse certificates such as X.509 has the potential to furnish the system with a heightened degree of security.

In addition, the adoption of ISO standards, including but not limited to ISO 1589, 19005, 27001, 32000, and 16175, would be highly beneficial. The standards mentioned above offer directives relevant to the administration, safeguarding, and availability of digital records, which are essential for the functioning of an e-Cabinet framework. Adhering to these prescribed guidelines can aid in guaranteeing that the system is in accordance with regulations, fortified against breaches, and easily navigable for individuals with impairments.

To clarify, the integration of established methodologies such as API standardization and adherence to ISO standards can effectively guarantee the interoperability, security, and accessibility of the e-Cabinet system, thereby rendering it a valuable asset for the country.

9 Conclusion

In conclusion, the establishment of an electronic Cabinet system necessitates a meticulous evaluation of diverse elements such as contextual analysis, fundamental components, structure, and established conventions. Prior to implementing the GovStack building blocks, it is imperative to comprehend the distinct prerequisites and constraints of the nation and its infrastructure. In addition, the essential building blocks such as Digital Registries, Registration, CMS, DMS, Workflow Engine, and Notification systems are crucial for the successful development of the e-Cabinet system.

The utilization of a hybrid architecture that combines microservices and layered architecture confers upon the system the desirable attributes of flexibility, scalability, and maintainability. Furthermore, it is crucial to uphold various customary procedures such as standardizing APIs, implementing Public Key Infrastructure (PKI), utilizing Lightweight Directory Access Protocol (LDAP), adhering to International Organization for Standardization (ISO) standards, and following database standards. The e-Cabinet system is designed to be interoperable, secure, and adhere to current standards of excellence.

In general, the successful establishment and development of an e-Cabinet system can yield manifold advantages for the government and its populace, such as heightened efficiency, transparency, and accessibility. It is important to take into account the particular circumstances and stipulations of each nation and to match them to established protocols in order to guarantee the success of the system.

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Appendix 1

Interview Questions

The interview questions are as follows:

i. What are the building blocks essential for e-Cabinet? What measurements are considered while developing an e-Cabinet over the existing BBs?
ii. What were the main aspects taken into account while doing the architecture comparison and mapping with GovStack's BBs and existing BBs? Does the comparison show any similarities in both of the BBs?
iii. What were the challenges faced while adapting GovStack's BB? Does the country think it is better to develop from scratch or adaption is the best approach?
iv. Were the challenges more related to the technical or operational sector?
v. Did the specific country and e-Cabinet match the technical requirements of GovStack?
vi. Does the country find the challenges faced while adapting GovStack's BBs intimidating and continuous?
vii. What technical framework or architecture has the country followed while developing the e-Cabinet?
viii. Does the country consider following further development based on GovStack's BB? If yes, how is that going to be?
ix. Does the country have policies or regulations which might not match to develop a GovStack-based solution?
x. What were approaches taken to understand the technical aspects? Does the country find it agile and flexible?

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