Universiteit Leiden

ICT in Business and the Public Sector

A Method for Integrating Enterprise Architecture: Case Study on the European Parliament

Name: Josipa Babić
Student-no: s3116611

Date: 15/09/2023

1st supervisor: Drs. J.B. Kruiswijk
2nd supervisor: Dr. G.J. Ramackers

MASTER'S THESIS

Leiden Institute of Advanced Computer Science (LIACS)
Leiden University
Niels Bohrweg 1
2333 CA Leiden
The Netherlands

A Method for Integrating Enterprise Architecture: Case Study on the European Parliament

Josipa Babić

Leiden Institute of Advanced Computer Science (LIACS)

Niels Bohrweg 1, 2333 CA Leiden, The Netherlands

September 15, 2023

Abstract

This research explores the integration of Enterprise Architecture (EA) within the European Parliament, aiming to uncover insights, challenges, and strategies for successful implementation. Through a comprehensive case study and interviews with key stakeholders, the study investigates the benefits, challenges, and practical implementation of EA integration in the public sector. The case study examines two departments, the Directorate-General for Translation (DG-TRAD) and the Directorate-General for Finance (DG-FINS), revealing overlaps and inefficiencies in EA modules. By employing design patterns, the integration process streamlines processes and fosters collaboration. However, limitations include diagram quality and inconsistent language patterns. The research offers insights into the necessity of standardized language, comprehensive adoption of EA, and cross-departmental collaboration. This study contributes to a broader understanding of EA integration, emphasizing the need for standardized practices and holistic departmental involvement for effective public sector transformation.

Key words: Enterprise Architecture, EA integration, public sector, European Parliament, ArchiMate diagrams, design patterns, operational efficiency, resource allocation, standardized practices, cross-departmental collaboration, transformation

Acknowledgements

I would like to begin by expressing my deepest appreciation to my boyfriend, Maarten ten Voorde, who deserves special recognition. He has been my constant travel partner throughout this entire journey and has played a pivotal role in helping me achieve this important milestone. His patience, unwavering support, and consistent presence have been invaluable.

I also want to express sincere thanks to everyone who was essential to the success of our project. First, I would like to express my profound gratitude to Bas Kruiswijk, who served as my primary supervisor and whose invaluable suggestions and insights greatly influenced the development of the project. I also wish to thank Guus Ramackers, my secondary supervisor, for his perceptive feedback.

I would like to extend my sincere gratitude to the entire team members of the European Parliament. Their constant assistance throughout this difficult period has been genuinely admirable and serves as the foundation for my thesis. I'd like to take this opportunity to thank the European Parliament for letting me contribute three articles on enterprise architecture to their private website.

I want to take a moment to express my gratitude to my family for their continuous support and patience during this process. Their unfailing confidence in my ability has served as a consistent source of inspiration.

Josipa Babic

Leiden, September 15, 2023,

Table of Contents

List of Figures

List of Tables

List of Abbreviations

EA	Enterprise Architecture
DG	Directorate General
TRAD	Translations Department
FINS	Finance Department
DODAF	Department of Defense Architecture Framework
ESB	Enterprise Service Bus
IT	Information Technology
EABM	Enterprise Architecture Benefits Model
ICT	Information Communication Technology
EAF	Enterprise Architecture Framework
ZFEA	Zachman Framework for Enterprise Architecture
TOGAF	The Open Group Architecture Framework
ADM	Architecture Development Model
SIB	Standards Information Base
BBIB	Blocks Information Base
DAF	Distributed Architecture Framework
MODAF	Ministry of Defence Architecture Framework
NAF	Nato Architecture Framework
C4ISR	The Command, Control, Communications, Intelligence, Surveillance, and Reconnaissance
OMB	Office of Management and Budget
PES	Physical Exchange Specification
CRM	Customer Relationship Management
PPT	People, Process, and Technology
GUI	Graphical User Interface
API	Application Programming Interface (API)
SOA	Service-Oriented Architecture
ROI	Return on investment
EP	European Parliamnet

EU	European Union
ERP	Enterprise Resource Planning
UX	User Experience
EGOV	E-Government

1 Introduction

1.1 Problem Statement

Enterprise architecture (EA) objectives and aspirations are changing rapidly as the relevance of technology in driving business value grows. The EA function is a critical component of the foundation that both permits and accelerates the technological transformation required by businesses to succeed in a digital-first future. The EA team's aims in this modern setting are threefold. The Enterprise Architecture (EA) is a framework for managing and aligning an organization's IT assets, human operations, and projects with its operational characteristics. Governments are multi-tier organizations with different departments responsible for different tasks. The government's initiative to enable government services throughout the union is complex and huge. However, there are a lot of struggles that the European Parliament is going through to create an integrated enterprise architecture. A well-defined EA can assist the government align its IT resources with its strategic plan for allowing Citizen Services to utilize these IT resources. It reduces costs and complexity while increasing business flexibility and process optimization. Even though the enterprise architecture is widely used in the private and public sectors, there is still a lack of documentation regarding EA in the Public Sector. One of the publications on the use of the EA in public sector is coming from the U.S. e-government [2]. The main issues are the complex application landscapes throughout the organization. There is no integration between departments, which makes communication and data sharing difficult [1]. The main goals of their actions are to streamline government operations and embrace a user- and service-centric mindset. This entails ceasing to participate in one-off projects and instead using a whole-of-government approach to find solutions built on reusable parts to cut down on needless redundancy. The European Parliament chose to apply the idea of EA, which seeks to enhance the quality and speed up the interaction between departments, to address the aforementioned issues.

Governments frequently customize their EA-development methodology [3]. Despite the huge interest in EA, particularly among governments in developed nations, there is little literature on the exact development technique utilized by these governments to construct their extensive government EA [4].

1.2 Objectives

The research is important because it will address the gap in the literature on the topic of EA in the Public sector. The private sector conducts the majority of EA research application, whereas the governmental sector does not. The goal of this research is to uncover successful ways for integrating enterprise designs as well as potential risks. In other words, how can organizations deal with integrating Enterprise Architecture, this research will look at the European Parliament as a case study. The research will focus on the two different departments inside the European Parliament. As not every department follows the same structure, but uses the same resources, there is a need to integrate them into a single component.

The project specifically aims to address the following question: How can enterprise architects be included in public-sector organizations? There are several steps that must be taken in order to answer the following question. The first section examines the benefits, advantages, and challenges of implementing EA, and the second section shows practical examples of integration EA in two particular departments within the organization [5]. This study's findings outcome can be used as a learning tool by governments that intend to launch similar initiatives. Future studies could compare the European Parliament's development strategy to similar projects in other governmental contexts to propose and standardize an EA framework for the public sector. This is expected to solve some of the limitations of existing enterprise-focused EA systems.

1.3 Research Question

In order to tackle the problems or issues that were explained above and to achieve the objective, a research question has been developed. The goal of the research is to assess how much enterprise architecture is being thought about in a sample of real-world public organizations from the perspectives of enterprise architecture theory and enterprise architecture practice. The study considers the scope of Enterprise Architecture practice in terms of 1) the main thought behind Enterprise Architecture, 2) the effects of the behind thought on Enterprise Architecture execution, and 3) the implications of organizations' different Enterprise Architecture scoping choices. The study attempts to answer the following research questions (RQs):

“How can European Parliament as governmental organization deal with integrating Enterprise Architecture?”

The sub-questions were created in order to help us answer the main question:

1. What is the expected benefit of Enterprise Architecture on the Public Sector organization?
1. What are the challenges, and best practices for integrating EA into the Public Sector?
2. How can the European Parliament apply those methods in the two departments that will be examined in the study case?
3. How can we generalize the method for integrating EA in the Public Sector?

1.4 Research Outline

The European Parliament is the focus of this study's exploration of the challenging landscape of integrating enterprise architecture (EA) into governmental organizations. The study is designed using an exploratory and inductive methodology, with the development of fresh insights being of top importance.

In the first stage of the study, academic and professional literature on the topic of EA integration in organizations is extensively reviewed. The goal of this in-depth examination is to lay the theoretical groundwork and platform for future research.

In the next phase, the research turns its attention to data gathering after laying a strong theoretical framework. Here, we use a qualitative methodology to explore the benefits, advantages and challenges of EA applications and their associated dynamics in a practical setting.

The interview approach is one of the main methods for gathering data. Key members of the European Parliament who are familiar with and involved in the EA application process will be interviewed. These interviews go into great detail about the initial version of the EA model and how it was used inside the organization.

In addition to interviews, we will also conduct testing and observation sessions. The testing process will assess the viability and efficiency of EA implementation in the context of the Parliament's operational framework, while the observational sessions will

allow us to capture valuable insights about the interaction between the organization's structures and processes, and the EA model.

Analyzing an EA diagram is a crucial step in our research technique. We will use the content analysis method, which is a methodical and objective way to interpret the symbolic and visual material included in the diagram, for this analysis. This study assists in discovering and comprehending trends, themes, and other vital information regarding the application of EA.

All interviews conducted for the study will be recorded for accuracy and transcribed in a tabulated format for ease of analysis and interpretation. This rigorous and methodical approach to data collection and analysis ensures the reliability and validity of our research findings.

Through this extensive, in-depth research process, we aim to shed light on how the European Parliament, as a governmental organization, can successfully integrate EA within its structure. The findings and insights generated from this research will undoubtedly contribute to the existing body of knowledge on EA integration and provide practical recommendations that could facilitate the process for similar organizations.

2 Literature Review

The relevant literature was analyzed in this chapter to support the approach of this research. Research-related subjects will be presented and debated.

2.1 Enterprise Architecture

2.1.1 Definition

Enterprise Architecture (EA) is a discipline that has grown in popularity among academic and practitioner communities over the last few decades. It is a strategic management approach that seeks to connect a company's business and technology objectives, processes, and resources in order to improve performance, lower costs, and increase agility [6]. EA provides a comprehensive perspective of a company's business and IT landscape and assists in identifying areas for improvement, standardization, and optimization [7]. EA, as described by Ross et al. [8], is "the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the company's operating model." The authors go on to say that EA is divided into four domains: business, data, application, and technology. Each domain represents a unique part of the organization's architecture and is critical for the efficient administration of IT resources and capabilities.

EA has been identified as an important enabler of digital transformation and innovation [9]. It provides a framework for businesses to define and implement digital strategies that are in line with their company goals and objectives. Furthermore, EA encourages the use of emerging technologies such as cloud computing, big data analytics, and artificial intelligence by making it easier to integrate them into existing IT environments [10]. Several studies have been conducted to explore the advantages of EA adoption. Research by Zachman [11], for example, found that EA can help firms cut expenses, boost productivity, and improve communication and collaboration across business groups. Another study, by Lapalme et al. [12], discovered that EA can lead to enhanced decision-making, agility, and innovation.

Despite its potential benefits, EA implementation can be difficult due to a variety of organizational, technical, and cultural reasons [13]. Several studies have found EA

adoption difficulties, such as a lack of senior management support, limited resources, and an aversion to change [14]. Organizations must build a clear understanding of the value proposition of EA, implement strong governance frameworks, and foster a culture of cooperation and creativity to overcome these challenges [14].

Finally, Enterprise Architecture is a strategic management discipline that provides a comprehensive perspective of an organization's business and information technology landscape. It assists firms in aligning their business and technology objectives, processes, and resources to improve performance, decrease costs, and increase agility. EA implementation might be difficult, but it provides enormous benefits to enterprises willing to invest in it.

2.1.2 Benefits of Enterprise Architecture

Numerous management techniques aim to improve the company, as is well recognized. The Enterprise Architecture is no exception; in order to make the financial commitments necessary to create it, it must provide benefits to the organization. The enterprise architectural objective must align with the objectives, aspirations, and level of investment of the organization [18]. Niemi is one of the researchers who conducted considerable research on the literature and practical application of the topic. Niemi's research showed four areas of enterprise architecture benefits: hard, intangible, indirect, and strategic. In his research, he challenged the examination of the benefits of enterprise architecture. The research presented many overlapping benefits, but in the end, there were many indirect and strategic benefits that were difficult to assign to EA techniques, and there were no clear assessment criteria connected with benefits [19].

Tamm et al.'s comprehensive approach to research provides an overview of EA benefits and benefit realization processes. It also included a theoretical approach to how EA may assist organizations. As a result of their research, they developed the Enterprise Architecture Benefits Model (EABM), which suggests benefit facilitators between the quality of an organization's EA practices and the organization's ability to profit from Enterprise Architecture. The authors distinguish two sorts of Enterprise Architecture benefits: those gained directly from the practice of Enterprise Architecture and those gained as a result of putting plans made with the assistance of various Enterprise

Architecture planning processes into action. Additionally, four key benefit facilitators are identified: organizational alignment, information availability, resource portfolio optimization, and resource complementarity. Success factors are directly related to Enterprise Architecture benefits since they are major contextual concerns affecting Enterprise Architecture benefit realization [20]. The theoretical model of enterprise architecture success factors and their function in bridging the gap between enterprise architecture practices and organizational benefits is further advanced by Mendling and Recker (2012a). It identifies four Enterprise Architecture characteristics (EA product quality, EA function setup quality, EA service, and EA cultural aspects) that contribute to Enterprise Architecture user satisfaction and intended and actual use of Enterprise Architecture [21] by adapting the traditional DeLone and McLean IS success model [22] in the context of Enterprise Architecture. With an emphasis on Enterprise Architecture capabilities, a new area of research on the advantages and success factors of enterprise architecture has emerged. The importance of Enterprise Architecture service capabilities and dynamic capabilities gained as a result of Enterprise Architecture implementation in business and IT-driven changes are highlighted by Shanks et al.'s (2020) investigation into the relationship between Enterprise Architecture advisory services and organizational benefits [23]. Van de Wetering (2020), continuing his examination of Enterprise Architecture based capabilities, investigates how dynamic Enterprise Architecture skills might lead to organizational benefits through enhanced process innovation and business-IT alignment. Van de Wetering, Kurnia, and Kotusev (2020) expand on this concept to include how Enterprise Architecture deployment strategies contribute to the development of dynamic capabilities [24]. The value generation mechanisms of Enterprise Architecture management are investigated by Ahlemann, Legner, and Lux (2021) using a resource-based theory approach. They contend that an organization's Enterprise Architecture management resources (human, technological, and intangible resources) lead to Enterprise Architecture management capabilities (EA planning, EA implementation, EA modeling, and EA governance), which lead to improved information system capabilities and, ultimately, to business value [25].

2.1.3 Architecture Domains

It is common in the architectural industry to classify corporate architecture into several categories and domains. According to (Hugoson, Magoulas, and Pessi 2008), these categorizations help companies discern between different types of questions and facilitate appropriate information [26]. There are four types of architecture: business architecture, data architecture, application architecture, and technological architecture.

Business Architecture

A business system with its customer and supplier environment is defined as business architecture. The corporate vision, strategy, goals, governance, organization, and important business processes all contribute to it. Business processes, laws, human resources, and information and communication technology are all part of the systems, which are disciplines of industrial engineering and management science. Company architecture serves as a vital link between company strategy and the other key architectural components [27].

A more modern practitioner's perspective is offered according to (Ulrich and Kuehn 2015), business architecture is a blueprint of the corporation that gives a shared knowledge of the organization and is used to match strategic objectives with tactical demands [28]. It is an abstract set of standardized perspectives that describe a specific business ecosystem. The following key "domain" types are among the foundational perspectives:

- What a business performs (capability)
- The vocabulary it employs (information)
- How is the business organized (organization - roles)
- How does the business deliver value to key stakeholders (value stream - procedures)

Each of these business viewpoints has value on its own, but when examined collectively, they serve as a crucial baseline that delivers substantial transparency from an internal and third-party interaction perspective [27]. Organizations that embrace

business architecture rely more and more on these standardized domain viewpoints for planning, impact analysis, operational delivery, and solution deployment.

Information System Architecture

Both Data Architecture and Application Architecture are integral components that together form the broader Information Systems Architecture. This integration recognizes the interdependence of data management and application design. Data Architecture provides the foundation for organizing and managing data assets, while Application Architecture defines the structure and interactions of software applications. The seamless interplay between these two architectural dimensions ensures that the organization's data and applications work harmoniously to support business processes and overall strategic objectives [30].

Data Architecture encompasses the management of logical and physical data assets as well as the resources dedicated to data management within an enterprise [30]. Within an enterprise's Data Architecture, three integral components, as outlined by [68], come into play:

- Outcomes: These encompass models, definitions, and depictions of data flows.
- Activities: Activities encompass the processes involved in shaping, implementing, and fulfilling the intentions set within the data architecture.
- Behaviors: Behaviors encapsulate the collaborative efforts, mindsets, and skill sets of the individuals and roles that influence an enterprise's data architecture.

Application Architecture is a foundational element in an organization's technological framework. It involves designing a structured plan for deploying and integrating software applications to support core business processes. This blueprint outlines how applications interact, ensuring seamless collaboration and efficient operations. By making strategic technology choices and defining interfaces, Application Architecture enhances communication between different software components. This approach promotes scalability, adaptability, and effective alignment with evolving business requirements, driving agility and operational efficiency [30].

Technology Architecture

Technology Architecture encompasses the infrastructure and systems necessary for the implementation and administration of information and application architectures. In the rapidly evolving landscape of technology, it's imperative that changes in this domain don't disrupt other sub-architectures. Aerts [31] labels this as the information and communication technology (ICT) platform architecture, which constitutes a foundational resource layer with multifaceted characteristics. This layer includes various components such as computers, networks, operating systems, and data management systems, all of which serve as the building blocks for constructing an enterprise's overall system. This domain resides within the realm of computer systems engineering disciplines.

Figure 2.1: *Domains of architecture and their relationships* demonstrates the link between the Business, Data, Application, and Technology Architectures [48]:

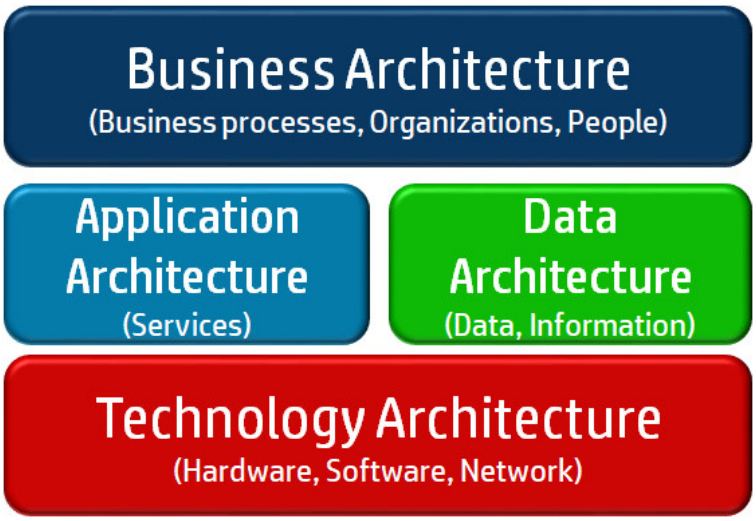

Figure 2.1: *Domains of architecture and their relationships*

2.1.4 Frameworks

There are numerous Enterprise Architecture (EA) frameworks that serve as crucial resources for guiding the practical application of EA within organizations. These frameworks are important as they bridge the gap between EA theory and its practical use within various management practices in organizations. Given the variety of EA frameworks that have been developed over time, each with slightly different origins and purposes, it's beneficial to discuss these frameworks and their contributions to the scope of EA.

Franke et al. (2009) highlight the diverse nature of EA frameworks, noting significant differences in their content [32]. They define an EA framework as a conceptual structure that guides the development of enterprise architectures, including models, principles, approaches, standards, and visualizations. The Enterprise Architecture Framework (EAF2) is then created by drawing common traits from a number of widely used EA frameworks. This strategy outlines two key framework elements: modeling principles and architecture governance, which are comparable to the dynamic and static EA views.

The most popular choices among organizations are the following EA frameworks:

1. Zachman Framework

John Zachman is universally recognized as the pioneer of Enterprise Architecture (EA). He drew inspiration from engineering disciplines and manufacturing processes to develop the Zachman Framework for Enterprise Architecture (ZFEA) [33]. The key insight that led to the creation of the renowned ZFEA was the understanding that different perspectives are crucial to any product, a concept he then applied to an enterprise [34].

Zachman observed that various engineered entities, such as computers, buildings, and airplanes, could be categorized based on fundamental questions: What? How? Where? Who? When? Why? These questions form the columns of the ZFEA. Additionally, specific audience perspectives and transformations form the rows.

The Zachman Architecture Framework (ZFEA) is a two-dimensional 6x6 classification schema meant to construct descriptive representations of an organisation (see ***Figure 2.2:*** *Zachman Architecture Framework*). It is also known as an enterprise ontology because it has no process or tooling implications [35]. The ZFEA can be viewed as an enterprise's meta-model, displayed in a matrix format with columns and rows. Each intersection of a column and a row provides a distinct perspective or vision of the business [36].

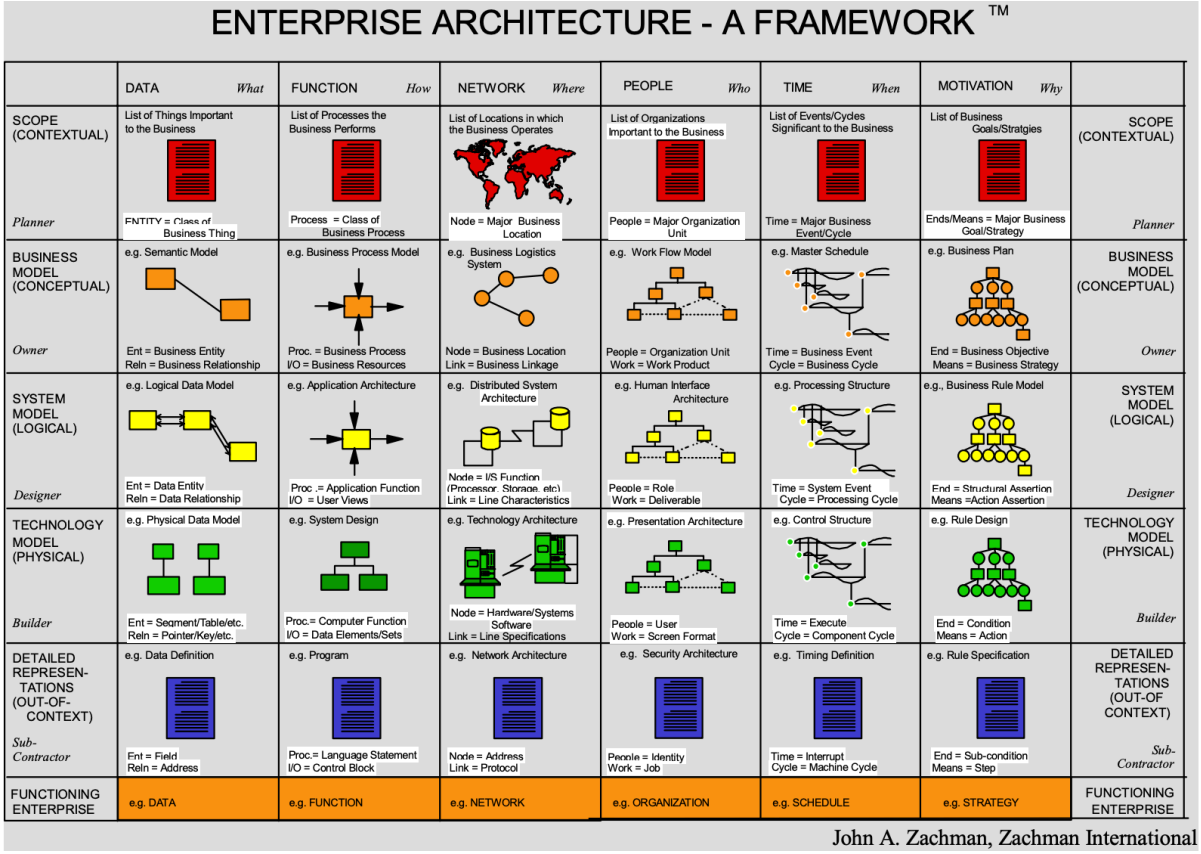

Figure 2.2: *Zachman Architecture Framework*

2. The Open Group Architecture Framework (TOGAF)

In 1995, The Open Group introduced the initial version of The Open Group Architecture Framework (TOGAF) [37]. TOGAF is not only a framework but also a method. It comprises several frameworks and methods aimed at aligning business vision and drivers with business capabilities.

The Open Group Architecture Framework contains four basic components (frameworks and methods):

1. **The Architecture Capability Framework**: This framework focuses on the organization, processes, skills, roles, and responsibilities necessary to establish and manage an architectural function within an enterprise [38]. This is shown in ***Figure 2.3:*** *The Architecture Capability Framework.*

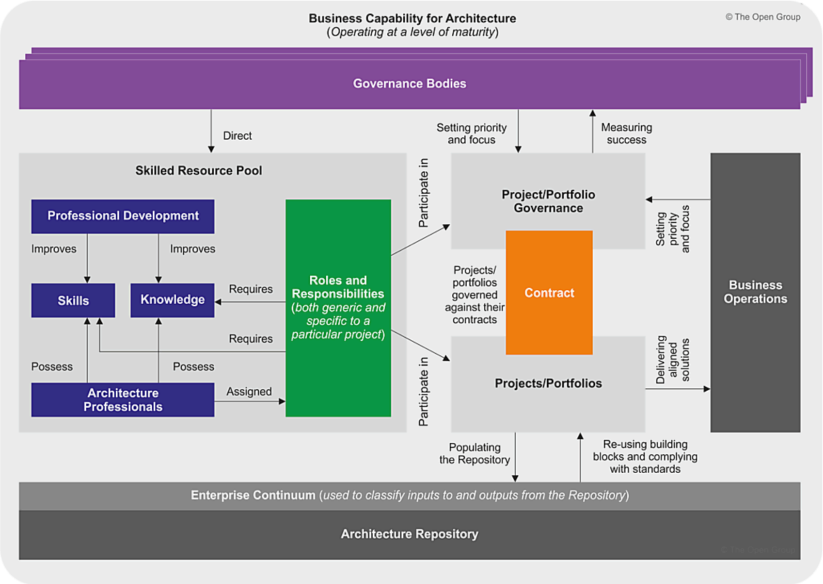

Figure 2.3: *The Architecture Capability Framework*

2. **The Architecture Development Method (ADM)**: This method is a step-by-step process for developing an enterprise-wide architecture. It can be thought of as a behavior' for Enterprise Architects. The ADM steps are illustrated ***Figure 2.4:*** *The Open Group Architecture Development* [38] .

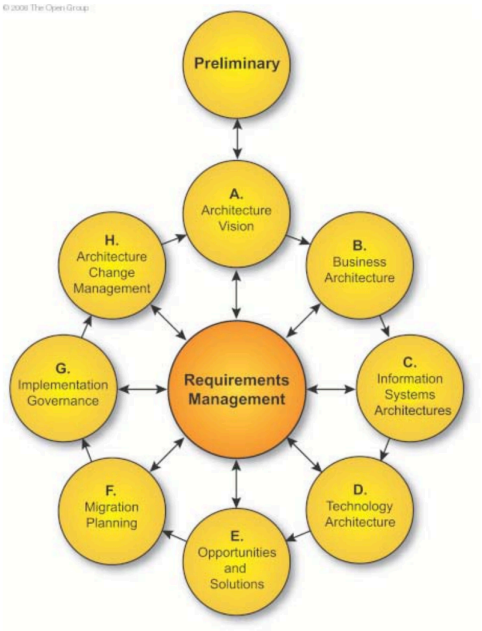

Figure 2.4: *The Open Group Architecture Development Framework*

3. **The Architecture Content Framework**: An overall Enterprise Architecture, according to this paradigm, consists of four closely related architectures: Business Architecture, Data Architecture, Application Architecture, and Technology (IT) Architecture [39]. The ***Figure 2.5:*** *The Architecture Content Framework* shows this.

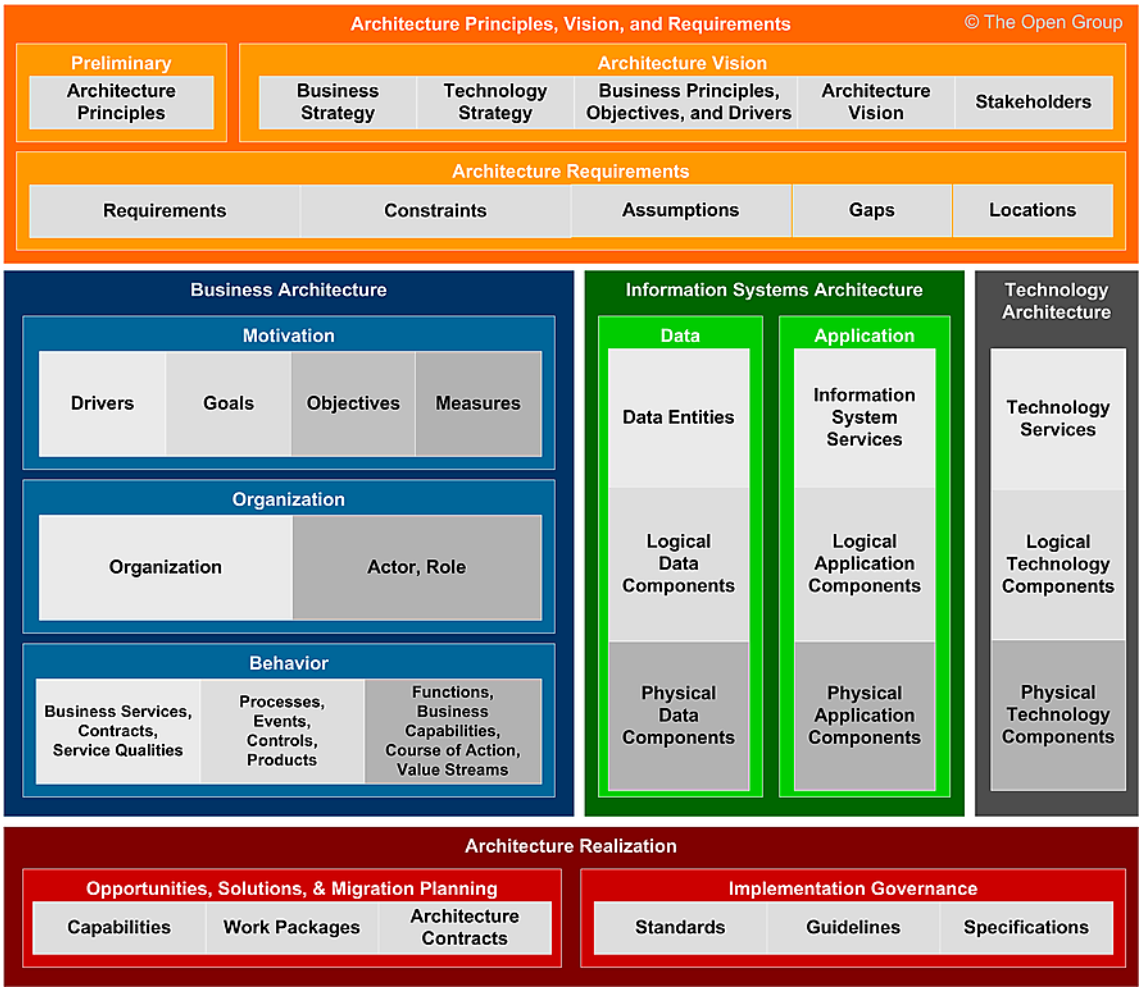

Figure 2.5: *The Architecture Content Framework*

4. **The Enterprise Continuum:** The Technical Reference Model, The Open Group's Standards Information Base (SIB), and The Building Blocks Information Base (BBIB) are all part of the Enterprise Continuum. The Enterprise Continuum idea demonstrates how architectures are created along a continuum, beginning with basic architectures and progressing through common systems architectures and industry-specific architectures to an enterprise's own unique architecture, as depicted in ***Figure 2.6:*** *The Architecture Content Framework* [39].

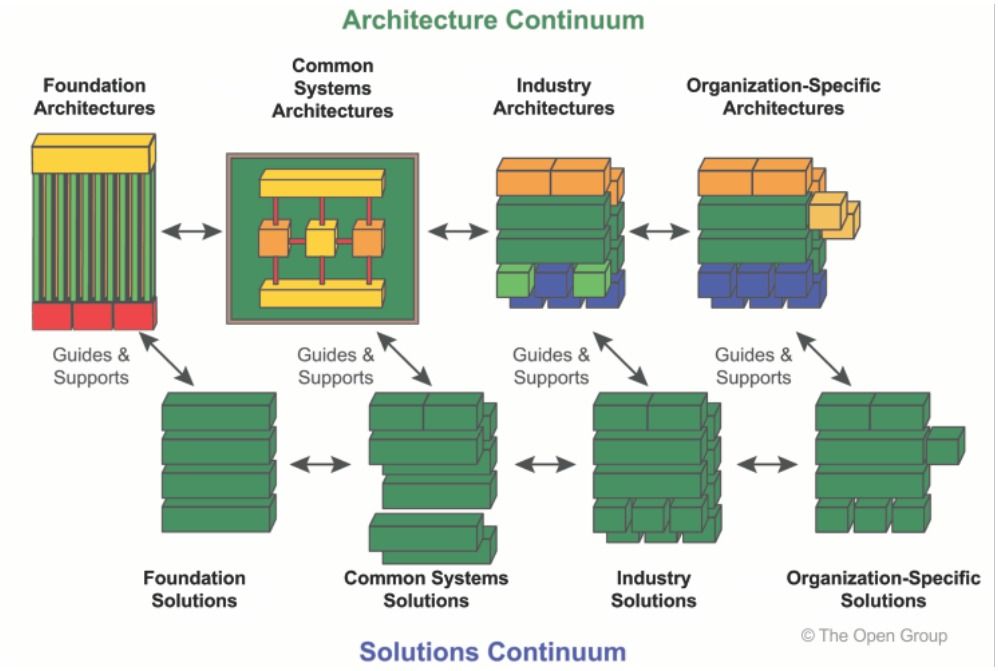

Figure 2.6: *The Architecture Content Framework*

3. DoDAF Architecture Framework (DoDAF), the variants (MODAF and NAF)

There are persistent obstacles in designing successful systems as the Department of Defense Architecture Framework (DODAF) reaches its 20th year. DODAF provides 51 models that can be implemented in a variety of standards, formats, and tools by a workforce with varying degrees of competence. As a result, a significant number of complicated architecture models are created that are frequently underutilized. It is critical to continue evolving ways that simplify and unify architectural methodologies and approaches in order to improve the practice of architecture [63].

Initially, the C4ISR Architecture Framework was introduced as guidelines, and DOD agencies were not obligated to design C4ISR architectures for system development initiatives. The Clinger-Cohen Act of 1996, on the other hand, required more structured and stringent protocols for IT purchase and administration. Initially, the C4ISR Architecture Framework was introduced as guidelines, and DOD agencies were not obligated to design C4ISR architectures as part of system development initiatives. The Clinger-Cohen Act of 1996, on the other hand, established more structured and rigorous

processes for IT procurement and administration. The DODAF enables the DOD 15 Chief Information Officer to support this Act, follow OMB recommendations, and comply with DOD orders and instructions [40]. The DOD CIO expects DOD components to follow the DODAF to the "maximum extent possible." This conformance facilitates information reuse, the sharing of architecture artifacts, models, and points of view, and the sharing of architectural knowledge. Conformance is accomplished when architecture data is represented using the DODAF Meta Model (DM2) and may be communicated in accordance with the Physical Exchange Specification (PES).

The framework is divided into models and viewpoints in DODAF 2.02. The models are artifacts that define various components of the goal design. DODAF does not describe the methods and techniques that system architects must use; however, the data produced must be compliant with the DM2. As illustrated in ***Figure 2.7:*** *DODAF eight viewpoints framework*, there are eight angles of view: DODAF eight views framework architecture consists of eight perspectives in total, with 51 models contained within these viewpoints. Architects create views and models based on their architectural goals. They also select the strategies, techniques, and tools used to construct the architectural objects. To develop an integrated architecture, all project/engineering management teams must use the same methodologies, strategies, and technologies.

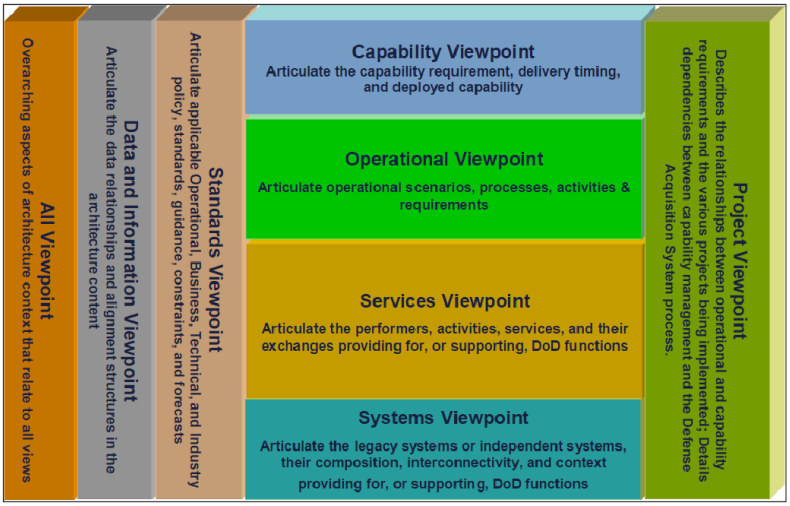

Figure 2.7: *DODAF eight viewpoints framework*

4. ArchiMate Core Framework

ArchiMate's framework initially consisted of three structures analogous to the components of human language: subjects, verbs, and objects. In ArchiMate, these are referred to as active structure, behavior, and passive structure elements, collectively known as 'aspects'. These aspects are replicated across ArchiMate layers, which are abstractions grouping elements with a common purpose in the enterprise. The original ArchiMate included a Business Layer, an Application Layer, and a Technology Layer [39].

The Business Layer depicts the products and services offered to clients via business processes performed by business actors. The Application Layer represents the application services that help businesses run and the programs that use them. The technical Layer represents the technological services required to run the applications, as well as the hardware and system software required to make such services a reality. The ArchiMate Core Framework is made up of these elements and layers [48].

In version 2, the framework was expanded with the Implementation and Migration Layer to model the migration path to the target architecture. An additional aspect, the motivation aspect, was added to describe the rationale behind the architecture.

ArchiMate 3 introduced elements to represent strategy and the physical world, resulting in two new layers. The Strategy Layer captures the strategic intent of the enterprise, defining courses of action and the capabilities and resources required to realize them. The Physical Layer covers material elements that are not IT. In the latest version of ArchiMate, the Physical Layer and the Technology Layer are viewed as one layer. These extensions form the ArchiMate Full Framework.

ArchiMate and TOGAF's ADM can be used together, as they cover much of the same ground. The Motivation aspect and Strategy Layer are used to establish the context around an EA model. The three core layers are used to depict the EA model’s Business Architecture, Information Systems Architecture, and Technology Architecture entities. Finally, the Implementation and Migration Layer is used to depict the Architecture Realization entities that capture the transition from the baseline to the target EA model [39].

2.1.5 Design Patterns

Enterprise Architecture (EA) patterns are introduced to provide guidance and best practices for designing and organizing enterprise architectures. They help architects make informed decisions, promote consistency, and address common challenges in large-scale system design and integration.
Firstly, there are patterns associated with core business processes grouped as 'Business Patterns'. Secondly, there are 'Support Patterns', linked to ancillary processes such as finance or human resources and the third category, 'Infrastructure Patterns'.
The application of these patterns depends largely on the problem at hand. Let's delve into a the patterns from a literature perspective.

The principles of enterprise architecture integration are divided into three layers: business, application, and technology. While these concepts are categorized into different layers, there can be overlaps and interdependencies between them. Integration efforts often require collaboration and alignment across multiple layers to achieve cohesive and effective solutions. The specific distribution of concepts can vary based on an organization's goals, needs, and existing architecture.

Business layer

Business Process Integration

In this pattern, different business processes are integrated, allowing data and information to move seamlessly across departments and functions [66]. This integration eliminates bottlenecks, redundancies, and communication gaps that can hinder productivity. It also promotes data consistency, as information is shared uniformly across processes.
Business Process Integration requires careful analysis of existing processes and their interdependencies [66]. This understanding guides the design and implementation of integration mechanisms such as workflow automation, data sharing protocols, and standardized communication interfaces. By successfully applying this pattern,

organizations can achieve smoother operations, reduced errors, improved decision-making, and enhanced collaboration among various departments and teams.

Application layer

Application Consolidation

The process of application consolidation involves several steps. It begins with a thorough analysis of the existing application landscape to understand the functionalities of the different applications and identify redundancies. This analysis can involve reviewing documentation, interviewing stakeholders, and examining data flows. Once redundancies are identified, the next step is planning the consolidation. This involves deciding which applications to consolidate, defining the functionalities of the consolidated application, and planning the data migration. The implementation of the consolidated application involves developing the application, migrating data, and testing the application to ensure it meets the requirements. Finally, the consolidated application is deployed, and the old applications are decommissioned [43].

Post-consolidation, organizations often implement a comprehensive system that integrates various functionalities. This consolidated system typically maintains a single database, eliminating the need for data synchronization and reducing the number of systems users need to interact with. This can lead to improved data consistency, a simplified user experience, and increased operational efficiency [44].

The literature suggests that application consolidation can result in significant cost savings and increased efficiency for organizations. However, it's important to note that the process of application consolidation requires careful planning and execution. The specific steps and outcomes can vary based on the specific context of the enterprise, including the complexity of the existing application landscape, the business processes involved, and the organization's strategic objectives [53].

Function Consolidation

Function consolidation, a core design pattern in enterprise architecture, consolidates and streamlines functions or processes into an integrated structure [49]. In complex organizations, its importance lies in minimizing redundancy and enhancing efficiency. It optimizes and unifies functions to reduce complexity while improving performance [51].

The resulting structure is more adaptable to change and growth without added complexity [52]. The Function Consolidation Design Pattern enhances efficiency and adaptability [49]. Further research can explore effective methodologies and its applicability in different industries [50].

Realization Alignment

The "Realization Alignment" design pattern focuses on ensuring that the implemented IT systems, applications, or components accurately reflect the intended architectural design and strategic objectives. This pattern seeks to bridge the gap between the conceptual architectural plan and the practical execution. It involves verifying that the realized solutions align with the planned architecture, ensuring that features, functionalities, and interactions are consistent with the overarching design [46].

In essence, the Realization Alignment design pattern aims to prevent divergence between the original architectural vision and the actual implementation. By continuously validating and comparing the realized systems against the architectural blueprint, organizations can maintain architectural integrity, reduce the risk of misalignment, and achieve the intended benefits of their enterprise architecture efforts. This pattern becomes especially important in complex projects where multiple teams or stakeholders are involved in the development process, as it helps maintain coherence and prevent inadvertent deviations from the architectural plan [46].

Application Component Design Pattern

The Application Component Design Pattern in ArchiMate focuses on modeling the logical structure of solutions within the Application layer. It employs elements like Application components, services, interfaces, processes, and functions to represent an

application's internal behavior and interfaces [53]. This pattern acknowledges two vital aspects: behavioral services and structural interfaces, both crucial for depicting an application's externally visible behavior. Application services handle functional interactions, while Application interfaces cover user interfaces and interactions with other apps [53]. This pattern guides the understanding and modeling of relations in the Application layer, aiding in representing complex interactions [53].

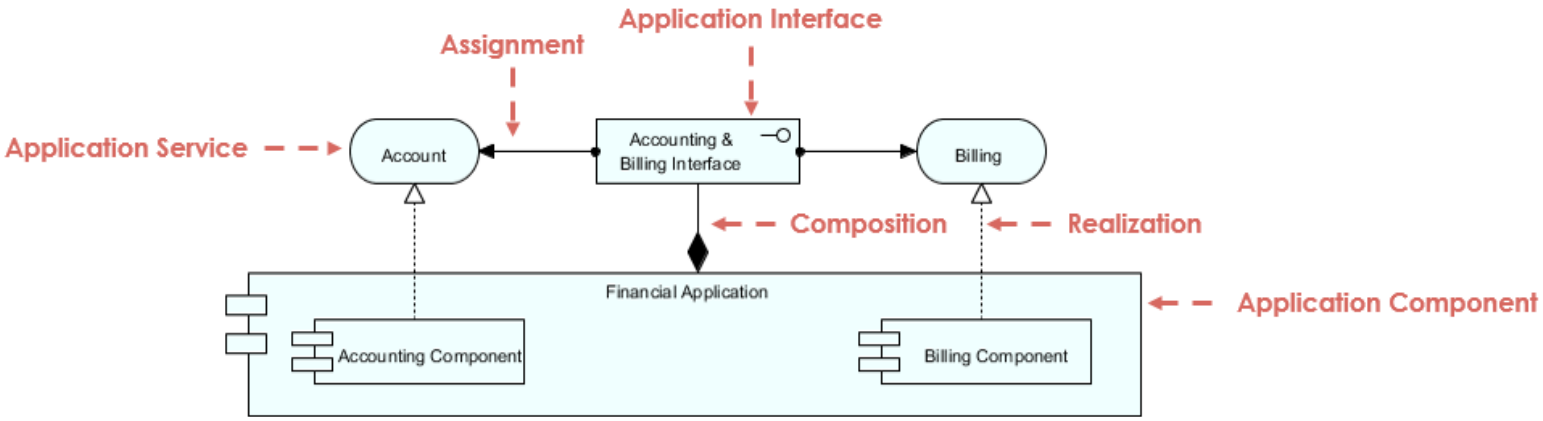

Figure 2.8: *Application Component Design Pattern*

In this ArchiMate diagram, we're looking at a financial application. It's split into two parts: one for accounting and one for billing. Each part offers a service that can be used by the system. These services can be accessed through a common interface called the accounting & billing application interface, which is part of the overall financial application.

Middleware Design Pattern

The middleware design pattern acts as a crucial link, integrating diverse systems in a standardized manner [64]. It enables communication and data exchange between software applications and services, particularly vital in the application layer [54]. In ArchiMate, this integral middleware is represented as an 'Application Component' in the application layer.

The 'Broker' pattern stands out within Middleware Design Patterns. A 'broker' component manages communication, forwarding requests, and transmitting results. In

Service-Oriented Architecture (SOA), the Enterprise Service Bus (ESB) often embodies this pattern, orchestrating service communication [46].

Middleware offers various advantages when applied in the application layer:
Decoupling: Applications are decoupled, ensuring changes in one don't affect others.
Interoperability: Middleware translates protocols and data formats for effective system interaction.
Scalability: It balances loads and routes requests for improved system scalability.
Data Transformation: Middleware converts data formats to suit receivers.
Security: Centralized security management, including authentication and authorization.
Error Handling and Retry: It manages errors and retries, boosting system robustness [54], [53].

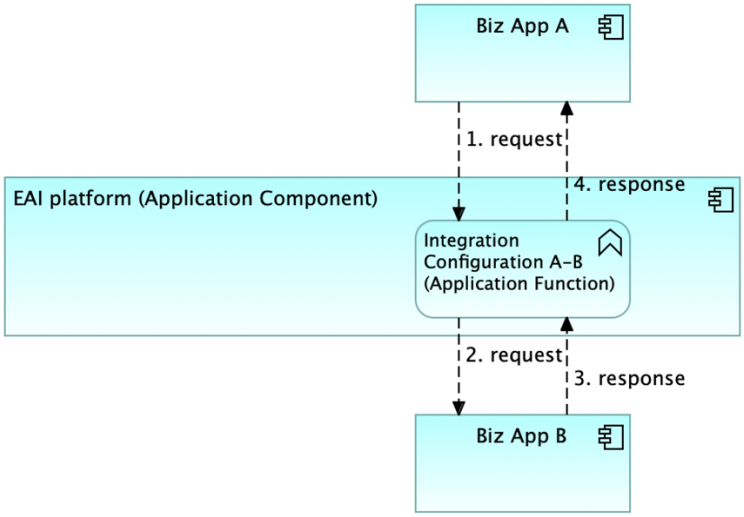

Figure 2.9: *The role of ESB as a middleware*

Technology layer

Cloud Integration and Hybrid Architecture

The Cloud Integration and Hybrid Architecture design pattern focuses on seamlessly incorporating cloud services alongside on-premises systems to optimize functionality, flexibility, and scalability [67]. This pattern acknowledges the advantages of both cloud

and local environments, aiming to strike a balance that suits the organization's unique needs [67].

In hybrid architecture, some services remain within the organization's infrastructure, while others are hosted in the cloud [67]. This offers benefits like cost efficiency, data security, and compliance with regulatory standards for sensitive information. Cloud integration ensures smooth communication and data exchange between on-premises and cloud-based applications, fostering a cohesive environment [67].

In conclusion, the effectiveness of these patterns is intrinsically tied to their careful selection and tailored adaptation to specific contexts. The successful integration of these patterns hinges on their alignment with the distinct requirements and limitations of the enterprise architecture. This study endeavors to delve further into the intricacies of these patterns, unraveling their practical significance and real-world applications. By doing so, it aims to illuminate the pivotal role these patterns play in elevating the scalability, reliability, interoperability, and modularity of complex systems. Through empirical exploration, this research aims to provide deeper insights into the impact and potential of these patterns within the realm of enterprise architecture [55], [56].

2.1.6 Integration Success Factors

The successful integration of Enterprise Architecture (EA) within an organization relies on various key factors that play a crucial role in ensuring its effectiveness and impact. In this section, ***Table 2-1:*** *Integration Success Factors*, outlines the essential integration success factors for EA. These factors encompass critical areas such as the purpose of architecture, alignment with development processes and operations, roles and responsibilities, monitoring and compliance, commitment and motivation, architectural tools, and consultation and communication [64]. Each factor is accompanied by a clear definition and references to relevant literature, offering valuable insights into the significance of these factors in driving successful EA integration. By understanding and implementing these integration success factors, organizations can effectively harness the potential of EA to align business goals, optimize processes, and achieve strategic objectives.

Integration key		Area Definition	Reference
1	The Purpose of Architecture	Architecture development is not a goal in and of itself. Architecture has a purpose; it must serve a purpose and be put to use. It can be used in a variety of ways, from serving as a simple information conduit to managing specific projects or even the entire corporation.	"it's also important to get involved in strategic planning with business units" [65].
2	Alignment with Development Process	The relationship between the architectural process and the development process, or the alignment with the development process, is crucial for achieving business objectives in the most efficient way possible.	"Follow a standard life-cycle model and delivery process, create the major deliverable listed within each lifecycle stage and to justify any exception" [65].
3	Alignment with Operations	Architecture is essential for development as well as for coordinating with operations and upkeep. Operational principles and norms must be incorporated into and built upon the design; these components reinforce one another.	"Eliminate duplicating technology, reducing costs." [57].
4	Roles and Responsibilities	Arguments and debates over architecture can be avoided if everyone is aware of their roles and responsibilities in terms of architectural behavior and thinking.	"There are a standard set of roles defined to support projects in establishing delivery teams to fulfil the main activities expected" [65].
5	Monitoring and Compliance	To guarantee that projects adhere to architecture throughout the project lifecycle, a control system is required.	"Exceptions are evaluated in case they justify improvements to governance or IT domains." [65].
6	Commitment and Motivation	The dedication and drive of the architectural stakeholders—architects, senior business and IT management, and project management—are essential to the design's uptake and success. This guarantees that the architectural process receives adequate time, money, and resources. Architectural artifacts (i.e., architectural concepts and models) ought to be encouraged at all managerial levels.	"Senior business managers share responsibility with IT managers for delivering business value from IT" [65].

7	Architectural Tools	Working with architecture can be made simpler by architectural tools. They ought to be competent for the task at hand. Combining instruments, especially with the aid of a repository, maximizes their effectiveness and efficiency..	"make effective use of tools and automation, and may be in turn be influenced by the available features of the tools" [65].
8	Consultation and Communication	Business managers, process owners, information managers, project managers, and IT specialists must be consulted while creating an architecture. These discussions help to clarify the architectural specifications and give the architecture's users (such as projects and operations) the chance to learn about the process's results.	"managers are educated to understand and play their role in the governance process and decisions are widely communicated to demonstrate that governance is working" [65].

Table 2-1: *Integration Success Factors*

2.2 Public sector from an EA standpoint

The purpose of this section is to lay the groundwork for distinguishing between public and private-sector Enterprise Architecture approaches. Understanding the distinctions between the two sectors, as well as their respective management styles, is required to justify the potential need for a public-sector EA strategy [16].

2.2.1 Public and Private Organizations

Economic entities are organizations that, directly or indirectly, seek to meet fundamental human needs. Private and public households, as well as organizations, are economic entities. Organizations are further classified as private, public, or third sector. ***Figure 2.10:*** *Economic entities adapted from (Lienert, 2009)* [58]. Third-sector organizations are hybrids of private and public organizations that are jointly owned. Private organizations are often for-profit enterprises that are not governed by the state. The state controls public-sector organizations, which are concerned with providing government services [62]. It is vital to emphasize that the public and private sectors are

not two different and internally homogeneous entities; only a few businesses are entirely public or wholly private. Most organizations fall somewhere on a spectrum between these two extremes, but for the sake of clarity, this work distinguishes between the labels private and public organizations [58].

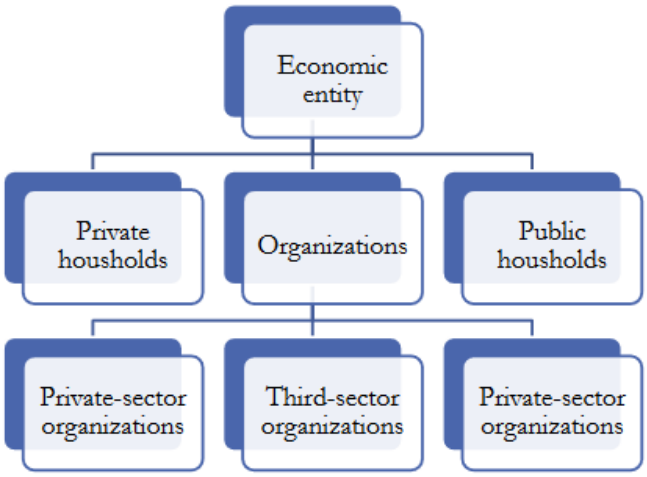

Figure 2.10: *Economic entities adapted from (Lienert, 2009)*

2.2.2 EA in Public Organization

Since the beginning of the 1990s, governments all over the world have started to take steps to utilize and employ information and communication technology (ICT) to enhance the delivery of public services. Citizens, business, and industry, as well as intra and inter-governmental entities, benefit from such services. Governments' transformational challenges include service evolution (customer-oriented services, entrepreneurial approaches to service delivery) and integration maturity (moving from vertical integration to horizontal integration). Governments have centered those transitions on government modernization programs, the primary goals of which are to improve the delivery of government services to residents and businesses while also increasing public-sector efficiency [29]. The development of these objectives, which can be summed up as effectiveness, efficiency, and agility (responsiveness), requires a mix of organizational and IT transformation techniques that have an impact on leadership, management, the division of labor, work processes, and competencies. Most governments around the world are undergoing significant public-sector transformation efforts. Enterprise Architecture methods are increasingly being used to efficiently and

successfully design and implement transformation activities [4]. The most powerful motivator for EA is to improve service delivery and overall performance throughout the organization's business sectors [17]. Public-sector organizations work tirelessly to address issues such as business-IT alignment, information accuracy and integrity, infrastructure management, security, technological compatibility, the business value of IT, IT governance, business collaboration, and procurement [4].

Category	Challenge(s)	Role of EA in Addressing Challenge(s)
Information and Data	Information and data quality	EA's Information Architecture (IA) mandates the establishment and adherence to standardized data standards. Such standards are typically captured as data principles/policies, as well as data definition and usage criteria. Mapping to apps and business processes provides full visibility and control over the data lifecycle. Such methods address concerns relating to data and generated information errors, inconsistencies, and incompleteness.
	Dynamic information needs	
Technology	Usability	Common technical and application standards are required for Technology Architecture (TA) and Application Architecture (AA). Non-functional requirements address architectural features. A set of important principles and common standards handle issues of incompatibility, complexity, and novelty. TA and AA can help agencies steer their technology purchase strategies.
	Security Technological incompatibility	
	Technology complexity	
	Technical skills and experience	
	Technology newness	
Organizational and Managerial	Project size and scope	Most countries maintain a distinct Programme Management Office (PMO) to handle the EA program (for example, the FEA PMO in the United States, AGIMO in Australia, and IDA in Singapore). The PMO deals with problems in this category. Transition management is a core activity in EA Management that handles some of the issues directly. Governance practices address some of the issues as
	Manager's attitude and behaviour	
	Stakeholder diversity	
	Lack of alignment	
	Multiple and conflicting goals	
	Resistance to change	

		well. These include, among other things, conventional project management methodologies, senior executive oversight, a formal compliance procedure, business leadership in project teams, and enterprise-level process owners[8].
Legal and Regulatory	Restrictive laws and regulations Annual budget cycles Intergovernmental relationships	These categories' challenges are best addressed by excellent architecture governance and management. Every architecture framework (for example, FEAF, DODAF, and TOGAF) places a high value on architecture governance.
Institutional and Environmental	Privacy concerns Autonomy of agencies Policy and political pressures Environmental context	Useful governance practices include infrastructure renewal funding, IT steering committee, structures, centralized funding for enterprise applications and portfolio management [8].

Table 2-2: *Role of EA in government transformation*

3 Research Methodology

This chapter describes the technique and methods used in this study, which are based on the literature review completed in chapter **2 Literature Review**. The evaluation of the literature served as the foundation for developing and substantiating the strategy discussed in this chapter.

3.1 Literature review

This study's research method focuses on two primary research questions:

- What are the expected benefits of Enterprise Architecture?
- What are the challenges and best practices for Enterprise Architecture integration?

To answer these questions, the investigation began with an in-depth study of the literature. The literature review fulfilled a pair of crucial roles. To begin, it intended to gather a fundamental understanding of Enterprise Architecture and its predicted benefits. Second, it aided in the identification of obstacles and best practices linked with Enterprise Architecture integration. As a result, the literature evaluation was critical in developing the theoretical framework for the data collection and analysis part of this research.

The study of important academic publications, industry reports, and scholarly sources connected to Enterprise Architecture and integration practices was the primary emphasis of the review. The search was carried out utilizing a variety of databases and search engines, including Google Scholar, IEEE Xplore, the ACM Digital Library, and others. The search terms used are detailed in the table below:

Category	**Search Term**	**Variations Used**
Enterprise Architecture	Enterprise Architecture	EA, Enterprise IT Architecture, IT Architecture
	Architectural Frameworks	Frameworks, TOGAF, Zachman Framework, ArchiMate
	Domains	Business domains, Technical domains, Information domains
	Patterns	Enterprise Architecture patterns, Design patterns

Expected benefits	Benefits	Advantages, Value, Impact, ROI, Business value
	Strategic alignment	Alignment with business goals, IT strategy alignment
	Cost savings	Operational cost reduction, Efficiency improvement
Integration Challenges	Integration challenges	EA integration challenges, Challenges in EA implementation
	Legacy system integration	Integration with legacy systems, Modernization challenges
	Data integration challenges	Data mapping, Data synchronization, Data quality issues
	Organizational resistance	Change management, Stakeholder buy-in
Best practices	Best practices	Success factors, Effective strategies, Recommendations
	Stakeholder engagement	Communication, Collaboration, Stakeholder management
	Governance practices	EA governance, Decision-making processes
	EA maturity models	Capability maturity models, Assessment frameworks

Table 3-1: *Terms used in searches for the literature review*

The literature review entailed a systematic study of the listed sources with the goal of collecting useful information about the projected benefits of Enterprise Architecture as well as the challenges and best practices connected with its integration. This thorough examination of current knowledge served as the foundation for additional investigation and analysis in this research project.

3.2 Data gathering

Following the completion of the literature review, the research shifted towards modeling the integration of two departments, specifically focusing on the case of the parliament. A combination of qualitative research approaches was used to collect data and answer the first two sub-questions. The use of a variety of qualitative research methods was intended to provide a full understanding of the integration process and its

related problems. These methodologies allowed for a more in-depth investigation of the research issue as well as a collection of rich and framed data.

3.2.1 Case study

In the study case of integrating two departments, document analysis played a significant role in gaining insights into the existing documentation related to the integration process. The document analysis involved a thorough examination of various documents, such as project plans, designs, road maps, meeting notes, and other relevant materials associated with the integration of the departments. This analysis was conducted separately for each of the departments involved in the integration. The purpose was to gather information about the objectives, strategies, and activities outlined in the documentation, providing a comprehensive view of what had transpired during the integration process. The findings from the document analysis served as a valuable resource for understanding the context, identifying patterns, and informing the subsequent stages of the research, including the formulation of interview questions and the exploration of integration challenges and best practices. Case analysis helped us to pick the combination of patterns using the ArchiMate framework. A thorough grasp of the ArchiMate framework and its application in combining two departments was acquired by a detailed analysis of existing literature, which included academic papers, industry reports, and the company documentation. Examining numerous sources to find established best practices, common problems, and viable techniques for pattern integration within the ArchiMate environment was part of the desk research. The study was able to inform the design of the integration process, identify potential difficulties, and develop a theoretical framework for the succeeding stages of the research by drawing on insights and expertise gathered from desk research.

3.2.2 Interviews

The primary data collection method employed in this research was conducting qualitative interviews using the general interview guide approach. The general interview guide approach ensured that consistent areas of information were covered with each interviewee while allowing flexibility and adaptability in gathering their insights [40].

Interview questions were developed based on the research questions, focusing on these general areas. Furthermore, additional tailored questions were asked, taking into account information obtained from the document analysis and earlier interviews. The interview protocol, outlining the specific questions and guidelines, **Appendix A: Interview Protocol** of this thesis contains more information. These interviews were conducted with Enterprise Architects or individuals in similar roles, such as directors or higher-level management positions, who had a strong interest in Enterprise Architecture. All interviews were taped with permission and afterwards transcribed. **Appendix B: Transcripts** contains transcriptions of these interviews.
Please note that **Appendix B: Transcripts** is provided separately from this thesis due to its extensive length. For a comprehensive overview of the interviewees and detailed information about each interview, please refer to ***Table 3-2:*** *Overview of Interviewees*:

No.	Role of the Interviewee	Date	Duration
1.	Enterprise Architecture unit Head of unit	24-5-2023	00:39:26
2.	Enterprise Architecture unit Head of Service	30-5-2023	00:37:21
3.	Enterprise Architecture unit Senior Enterprise Architect Administrator	25-5-2023	00:37:13
4.	Enterprise Architecture unit Business Analyst Administrator	16-5-2023	00:41:37
5.	Enterprise Architecture unit Senior Enterprise Architect	31-5-2023	00:38:35
6.	Enterprise Architecture unit Senior Solution Architect	25-5-2023	00:38:29
7.	Enterprise Architecture unit Senior Enterprise Architect	16-5-2023	00:32:21
8.	Enterprise Architecture unit Senior Enterprise Architect	24-5-2023	00:49:47
9.	Enterprise Architecture unit Senior Enterprise Architect	31-5-2023	00:39:43
10.	Enterprise Architecture unit Senior Enterprise Architect	25-5-2023	00:40:27

Table 3-2: *Overview of Interviewees*

Interview analysis

The data acquired through interviews and document analysis was subjected to a comprehensive data analysis methodology. This entailed organizing, categorizing, and evaluating the data in order to obtain relevant insights and patterns. The data analysis process was qualitative, allowing for a more detailed study of the research issues and capturing the many viewpoints of the participants. To uncover major themes, repeating patterns, and notable results in the data, various techniques such as thematic analysis and coding were used. A deeper understanding of the integration process, its obstacles, and best practices emerged as a result of this careful investigation, adding to the overall aims of the research.

The grounded theory

The principles of Grounded Theory were used as a systematic and explicit way to examine the textual material produced from the collected data in this study. Martin and Turner (1986) define grounded theory as an inductive process that allows scholars to create a theoretical grasp of a topic while rooting it in empirical observations or data [59]. Following the Grounded Theory eight-step method, the substantive area of interest was selected, data pertaining to that area was gathered, and an open coding technique was used to categorize the data. Memos were written during the process to capture crucial reflections and discoveries. To improve the study, selective coding and theoretical sampling were used. After that, memos were sorted, and theoretical codes were created to organize the substantive codes. Following that, the literature was studied, and selective coding was employed to connect it with the emergent theory. It is crucial to emphasize that, while this study used elements of Grounded Theory, it did not strictly follow the approach. This study concentrated on the systematic processing and analysis of textual data using coding techniques and labeling. This procedure will be explained in further detail in the next sections of this chapter.

Coding the interviews

Coding is a critical component in qualitative research for organizing and analyzing data [60]. Saldana (2009) defines coding as the assignment of a word or phrase to symbolically represent a meaningful attribute or essence of a portion of data [61].

Through coding, theoretical meaning and deeper insights can be constructed from the collected data [60].

In this research, all interviews were transcribed, and the textual data was coded. The coding process was conducted in multiple stages, corresponding to different categories. There was a unique set of codes and themes for each category. Data's underlying themes are revealed by coding techniques, assisting in the creation of meaning [60].

Open coding, axial coding, and selective coding are three styles of coding frequently employed in qualitative research [60]. Open coding involves identifying distinct concepts and themes in the data, resulting in broad initial thematic domains [60]. Axial coding refines and categorizes the emergent themes, establishing relationships between the open codes [60]. Selective coding further reduces the number of codes and enables the selection and integration of organized data categories into meaningful expressions [60].

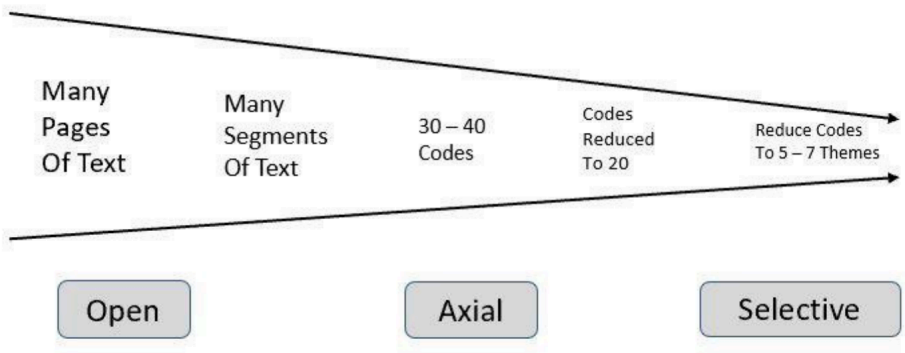

Figure 3.1: *Types of coding techniques that can be used in qualitative research.*

This coding procedure makes it possible for the researcher to continuously engage with the data, compare it, and use data consolidation and reduction strategies [60]. Essential themes are identified, codified, and interpreted, aligning with the research focus [60].

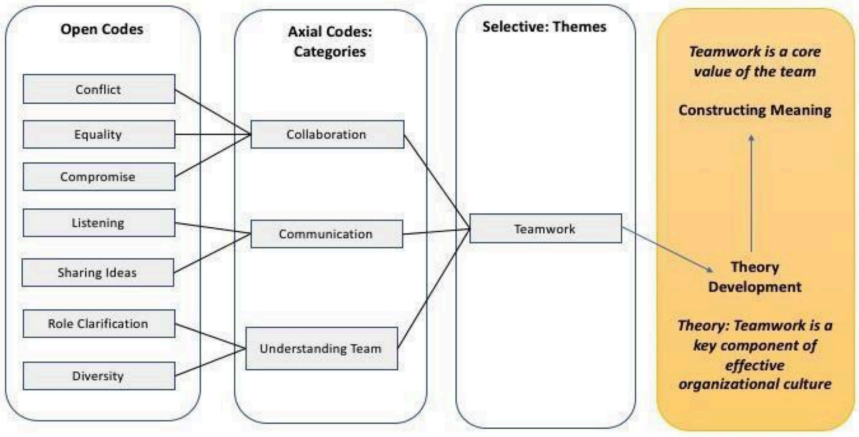

Figure 3.2: *An illustration of moving from coding to theory development.*

By employing coding methods, theories can be developed based on the identified themes. The coding process allows for a dynamic and nonlinear approach, enabling researchers to capture essential insights and interpretations throughout the research journey [60].

Creation of Results

Figure 3.3: shows the results of an open, axial, and selective coding method that was applied to the data gathered for this study.

It is crucial to understand that this coding procedure is dynamic and iterative rather than linear and that it changes as the research goes on.

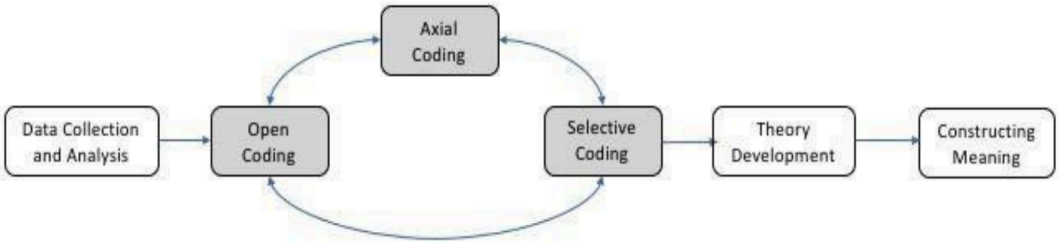

Figure 3.3: *The method used for coding qualitative research*

The coding procedure in this study took a similar course to that shown in ***Figure 3.3:*** . Due to its length, **Appendix C** is given separately from this thesis and contains the codebook that was utilized in this study.

Based on the codes that emerged from the data, themes were identified through selective

coding. Each of the 10 interviews, served as the foundation for the creation of results and the construction of meaning. These codes can be found in **Appendix C**, which is given separately from this thesis due to its large page number and reflects the development of ideas based on the identified themes.

The coding process, guided by the codebook, played a crucial role in organizing and analyzing the data, facilitating the exploration of patterns and themes, and contributing to the overall findings of the research.

3.3 Validation

The research steps discussed in this chapter, such as theory formulation, coding, and meaning construction, generated results. A comprehensive examination of the diagrams was performed collaboratively with Senior Architects who have substantial knowledge of the industry to validate these conclusions.

The validation process was created in response to the findings reported in **Chapter 4 Results**, as well as the main findings summarized in **Chapter 5: Summary of key findings**. The protocol included particular questions and criteria based on the research findings.

The results of the validation process are given in Section **5.3 Validation**. This section covers how the diagrams were reviewed, the assessment criteria utilized, and the insights acquired from the validation. The participation of Senior Architects increased the rigor and skill of the validation process.

3.4 Overview

This chapter offers an in-depth examination of the technique and approach used in this study, which concentrated on the integration of Enterprise Architecture. The required information was gathered using a variety of techniques, such as a literature review, desk research, case analysis, and qualitative interviews. Using coding techniques, the gathered data was processed, resulting in the discovery of themes and the creation of theoretical frameworks. These theories played a key role in developing accurate data interpretations.

The main outcomes and conclusions of the research were validated through conversations with a senior architect, who offered insightful commentary and input, in order to confirm the validity and dependability of the findings. The trustworthiness of the research's findings was strengthened by this validation method.

The ideas and built meanings resulting from the analysis are presented in Chapter 4, which is labeled "**Results,"**. It will give a thorough explanation of the main conclusions and how they affect the integration of enterprise architecture.

Figure 3.4: *The process of the research* provides a summary of the research technique and the numerous actions that were followed during the course of the investigation. It effectively conveys the methodical technique used in this investigation.

Overall, this chapter sets the stage for the upcoming presentation of the study findings by establishing a clear grasp of the research approach and methodology.

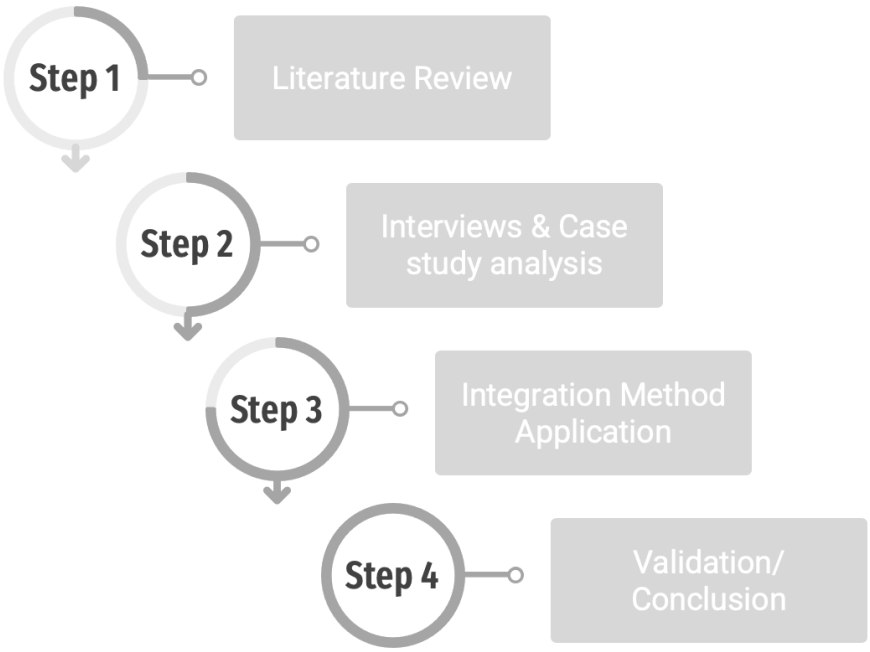

Figure 3.4: *The process of research*

4 Integration Method Design

The European Parliament is a complex and multifaceted institution that requires comprehensive and coordinated management of its various functions. The complexity of its operations, comprising political decision-making, legislative processes, administrative tasks, communication, and more, calls for an integrated approach to its systems and applications.

In addressing the challenges faced by such a prominent institution, the utilization of Enterprise Architecture (EA) patterns is not just a theoretical exercise but a vital necessity. This chapter illustrates the rationale behind employing specific EA patterns in the European Parliament case study, emphasizing their practical relevance and alignment with the institution's unique needs and objectives. Our method takes a systematic approach, combining comprehensive analysis, architectural alignment, and the strategic application of design patterns to achieve a seamless integration. Here is an in-depth exploration of the integration methodology:

4.1 Identification of Shared Capabilities

The first step in the integration process includes an in-depth evaluation of Department A and Department B. Finding the points where the duties and responsibilities of various departments overlap is the main goal. These overlapping areas are known as "shared capabilities." The integration program is centered around them because they represent crucial intersections where Department A and Department B must work together seamlessly. Consider this as the identification of shared goals or objectives between two organizational units. This stage is crucial since it allows to clearly pinpoint the integration requirements.

In the **5.2 Case study** section, each shared capability is methodically identified and outlined, demonstrating the practical application of this identification process within the European Parliament case study.

4.2 Unify EA modelling

It becomes essential that the collaborating departments' Enterprise Architecture (EA) models be in sync. This alignment serves a crucial function as an introduction to upcoming integration initiatives. The integration of EA models from Departments A and B is part of our strategy, with an emphasis on isolating and separating shared capability-related components.

The result of this consolidation is the development of an integrated EA model. The complete integration process is supported by this unified model, which also provides a thorough and organized blueprint for upcoming integration projects. It makes sure that the architectural framework addresses shared capabilities holistically.

For a successful integration process, the unified EA model brings together many components and offers the necessary coherence and clarity.

In section **5.2 Case study**, a detailed explanation of how unified enterprise architectures are involved and how the segments related to shared capabilities are isolated is provided, providing a comprehensive understanding of the practical application of this critical step within the European Parliament case study.

4.3 Selection of Design Patterns

This section delves into the process of selecting design patterns. This process is informed by a thorough literature review completed in section **2.1.5 Design Patterns**. These design patterns have been carefully selected based on concepts and expertise obtained through an extensive literature review.

The process consists of an in-depth examination of a wide range of design patterns, each precisely designed to handle specific integration issues. The goal is to offer a clear and compelling reason for the inclusion of each selected pattern.

Justification of Methods:

4.3.1 Application Consolidation

The European Parliament's digital infrastructure likely comprises a myriad of applications, reflecting its diverse functions and responsibilities. Application consolidation can significantly enhance operational efficiency by reducing redundancy and complexity. Relevance to the Case: In an environment where consistency and accuracy of data are paramount, unifying systems can prevent inconsistencies and facilitate a seamless information flow. This approach supports the integration of distinct systems like legislative tracking, public communication, financial management, and human resources, fostering collaboration and decision-making efficiency.

4.3.2 Realization Alignment

Aligning the Parliament's conceptual design with its technical implementation ensures that the architecture corresponds with legislative and administrative goals. Relevance to the Case: The mapping of business strategies to technology ensures that the entire digital ecosystem of the Parliament resonates with its core mission and values. It also ensures compliance with legal requirements, an essential aspect given the regulatory nature of the institution.

4.3.3 Function Consolidation

Given the multifunctional nature of the Parliament, a consolidation of various functions could lead to a streamlined process. Relevance to the Case: Function consolidation may facilitate the integration of various committees, political groups, and administrative departments, reducing redundancy and enhancing efficiency. This could be vital in areas like legislative drafting, where collaboration and coherence are essential.

4.3.4 Middleware Design Pattern

Integrating different systems within the European Parliament requires standardized and controlled communication.Relevance to the Case: Middleware facilitates inter-system communication, allowing disparate applications to interact. This is vital in a complex environment like the European Parliament, where different departments and functions

must work in unison. It ensures a harmonious relationship between technological components, which is vital for a transparent and effective legislative process.

The adoption of these methods in the European Parliament case study isn't a mere theoretical exercise; rather, it's a well-thought-out strategy to address real-world challenges faced by a complex political institution. The selected patterns align with the Parliament's needs for efficiency, coherence, transparency, and compliance.
The integration of these methods represents a tailored approach to managing the diverse and intricate landscape of the European Parliament, illustrating the adaptive and robust nature of Enterprise Architecture. In doing so, it not only addresses immediate operational challenges but also lays the groundwork for a future-ready, responsive, and resilient digital architecture.
By grounding the selection and application of these patterns in the specific context of the European Parliament, this study contributes to the practical discourse on Enterprise Architecture, offering insights and lessons that may be applicable to other complex organizations navigating similar challenges. In chapter **"Results"**, we will delve into the practical application of these patterns, providing an in-depth exploration of how these methodologies have been specifically utilized and adapted to address the unique challenges and requirements of the European Parliament case study.

The **5.2 Case study** section provides real-world proof of the practical implications of various design principles. The graphical explanation of how each pattern is efficiently implemented in the context of the European Parliament case study.

4.4 Development of a Unified Enterprise Architecture Model For Shared Capabilities

The main goal at this level of integration is to create a unified Enterprise Architecture (EA) diagram that includes common requirements. The main objective is to create a single, unified EA diagram that can accommodate the various needs of several departments. The goal of this unification is to increase interaction between departments, improve operational efficiency, and foster organizational collaboration.

In many organizational contexts, attention is often directed toward specific departments, commonly referred to as Department A and Department B, within the complex structural framework. These divisions have their own EA diagrams, which call for investigation to identify situations where integration is both beneficial and necessary. In order to find and take advantage of integration opportunities inside their operational frameworks, different enterprises may find this methodical approach to be a useful tool.

It soon became clear that a new diagram needed to be made in order to improve and streamline the organizational structure. This freshly created diagram combines the crucial elements needed by both Departments A and B. Importantly, it should be noted that this graphic is designed to act as a shared resource available to other departments within the business and is not restricted to the limits of these two departments.

Section **5.2 Case study** goes deeper into the operational implications of this shared EA architecture within the context of the European Parliament. As a result, this chapter acts as an introduction, laying the way for an in-depth investigation of the unified diagram's concrete implementation and benefits.

5 Results

In this section, we present the outcomes of our research, which combined insights from interviews and a comprehensive case study to explore the integration of Enterprise Architecture (EA) within the two departments of the European Parliament. The main objective was to identify opportunities for EA integration, streamline processes, and optimize resources to enhance budget execution efficiency.

The research journey began with in-depth interviews with key stakeholders, domain experts, and IT specialists from various departments within the European Parliament's IT department. Through these interviews, we sought to understand the existing challenges, complexities, and potential areas for improvement related to budget execution capability. These interviews provided valuable insights into the perspectives and needs of different departments and laid the foundation for our subsequent case study.

The case study delved into the architectural landscapes of two different departments within the public sector, both involved in budget execution processes. Initially operating independently, the case study revealed significant overlaps and redundancies in their ArchiMate diagrams. Recognizing the potential for improvement and cost-saving opportunities, the decision was made to merge the two ArchiMate diagrams into one.

The integration process aimed to eliminate duplications, foster collaboration, and align the business and IT strategies of both departments. By leveraging proven EA methods and patterns, we sought to create a unified and cohesive enterprise architecture that facilitates seamless budget execution processes. The case study involved consultations with domain experts, IT specialists, and key stakeholders from both departments. Their valuable input helped refine the integration approach and validate the proposed solutions.

Throughout this section, we will present the empirical findings derived from both the interviews and the merged ArchiMate diagram. This integrated approach offers a

comprehensive understanding of the challenges faced and the desired outcomes expected from the integration of EA in public sector budget execution.

Our research provides valuable insights for public sector organizations seeking to harness the potential of EA to optimize budget execution, enhance operational effectiveness, and deliver better public services to citizens. By combining interview data with a case study, we offer a robust foundation for organizations to make informed decisions and embark on successful EA integration journeys in the context of public sector budget execution.

5.1 Interviews

Based on the data collected through the semi-structured interviews, the following ***Figure 5.1**: Enterprise Architecture impact on European Parliament* has been created, which illustrates the impact of Enterprise Architecture on European Parliament institutions.

				EA impact on the organization									
Elements			Summary	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8	Interviewee 9	Interviewee 10
Sub Question 1	Benefits of Enterprise Architecture	Alignment of Business and IT	High	Medium	High	High	Medium	High	High	High	High	High	High
		Decision-making and Performance	High	High	High	Low	High	High	High	High	High	High	High
		Complexity Management	High	Medium	High	High	High	High	High	High	High	Medium	Medium
		Collaboration	High	High	High	High	High	High	High	High	High	High	High
Sub Question 2	Challenges of integrating EA	Cultural and human factors	Low	Medium	Low	Low	Low	Low	Low	Medium	High	Low	Medium
		Complexity of the Organization	Medium	Medium	High	High	High	High	Medium	Low	Medium	Medium	Medium
		Resource constraints	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
		Promoting Enterprise Thinking and Mindset Shift	Medium	High	High	High	High	High	Medium	Medium	Medium	Medium	Low
		Silo Mentality	High	High	High	High	High	High	Medium	Low	Medium	High	High
	Best practices	Governance and Structure	Medium	Medium	High	Low	Medium	Medium	Medium	Medium	Medium	High	High
		Stakeholder Engagement and Communication	High	High	Low	High	High	High	Medium	Medium	High	High	High
		Resource Allocation and Management	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium
		Measurement and Evaluation	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High	Medium
Main RQ	EP integrating Enterprise Architecture?	Assessing EA Readiness	Low	Low	Medium	Low	Low	Medium	Low	Low	Medium	Medium	Medium
		Identifying EA Maturity Level	Medium	Low	High	High	High	Medium	Medium	Medium	Medium	Low	High
		Selecting an Appropriate EA Framework (e.g., TOGAF, Zachman)	Medium	Low	High	Medium	Medium	Medium	Low	Medium	Medium	Medium	Low
		Customizing the EA Methodology for the European Parliament's Needs	Low	Low	Low	High	Medium	Low	Medium	Low	Low	High	High

***Figure 5.1**: Enterprise Architecture impact on European Parliament*

Our main research goal is to figure out how the European Parliament, a key governmental body, can integrate Enterprise Architecture (EA). To get a clearer understanding, we've broken this down into three specific questions.

We gathered insights through interviews and then coded the responses to find important themes or factors related to our main question.

Interpretation of the Data Table

Elements & Themes: The 'Elements' column lists the dominant themes or codes that interviewees frequently mentioned as they relate to the sub-questions.

Code Importance: The 'Summary' column offers a snapshot, indicating how significant each theme is, considering the perspectives of all interviewees.

Individual Perspectives: Columns dedicated to each interviewee offer a more detailed look, revealing their personal views on the relevance of these themes in the context of the European Parliament's EA integration efforts.

In essence, this ***Figure 5.1****: Enterprise Architecture impact on European Parliament* provides both a general overview (from the 'Summary' column) and nuanced insights (from individual columns) on how specific themes or factors might influence the European Parliament's journey to integrate EA.

High Impact

Based on the analysis of the interviewees' perceptions, several elements were identified as having a high impact on enterprise architecture:

- Collaboration and Communication: All interviewees (10/10) highlighted the significant influence of enterprise architecture in fostering collaboration and improving communication within the organization.
- Decision-making and Performance: For many interviewees (9/10), enterprise architecture plays a crucial role in enhancing decision-making processes and overall performance.
- Complexity Management: The impact of enterprise architecture on managing organizational complexity was noted by most interviewees (9/10).

- Silo Mentality and Lack of Collaboration: A significant number of interviewees (9/10) emphasized that enterprise architecture effectively helps overcome silo mentality and promotes collaboration across departments.
- Stakeholder Engagement and Communication: Most interviewees (9/10) acknowledged the positive impact of enterprise architecture on stakeholder engagement and communication.
- Alignment of Business and IT: Most interviewees (8/10) argued that enterprise architecture greatly affects the alignment between business and IT.

These findings demonstrate that enterprise architecture significantly contributes to improved collaboration, decision-making, complexity management, breaking down silos, and enhancing stakeholder engagement and communication within organizations.

Medium Impact

For several components, the impact of enterprise architecture was deemed to be medium, suggesting that these elements are affected but not to a great extent. These components include the complexity of the organization, Resource constraints, Promoting Enterprise thinking and mindset shift, Governance and structure, Resource allocation and management, Measurement and evaluation, adentifying the EA maturity level, and selecting an appropriate EA framework (e.g. TOGAF, DODAF). According to most interviewees (10/10), the impact of enterprise architecture on Resource constraints is characterized as moderate, with resource allocation and measurement evaluation also being significantly influenced (9/10). Similarly, the elements of Governance and structure and selecting an appropriate EA framework were moderately impacted by enterprise architecture, as per many interviewees (6/10). The components of Promoting Enterprise thinking, and mindset shift, Complexity of the organization, and Identifying EA maturity level were also affected by enterprise architecture to some extent, though this impact was moderate (4/10).

Low Impact

Certain components were observed to have the least impact or were minimally affected by enterprise architecture, including Cultural and human factors, Assessing EA

readiness, and Customizing EA methodology for the European Parliament. Most interviewees (6/10) stated that Cultural and human factors and customizing EA methodology for the European Parliament had a very slight impact due to the development and deployment of EA technologies. Furthermore, the impact of enterprise architecture on the Assessing EA readiness component was low, as mentioned by many participants during the semi-structured interviews (5/10).

Summary of interview findings

The interviews provide valuable insights into the challenges and strategies associated with integrating enterprise architecture (EA) into organizations, particularly in the context of the public sector. One interviewee notes that the integration process requires a centralized repository for informed decision-making and stakeholder engagement, enabling a comprehensive approach beyond IT origins:

"The integration process centers around a centralized repository enabling informed decision-making and comprehensive stakeholder engagement".

Overcoming resistance is highlighted as a communication-driven strategy, presenting tangible benefits to stakeholders to optimize operations:

"We have learned to present tangible benefits to optimize and improve our operations".

The complexity of public sector IT landscapes is addressed through EA's role in systematizing and comprehending the intricate environment: *"Enterprise architecture provides a holistic overview that enables better analysis and understanding"*. Notably, EA's impact on decision-making is evidenced by evaluating projects' alignment with IT landscapes and contributing to shaping IT strategy *"We can assess the impact of IT projects and contribute to shaping the IT strategy"*. EA's alignment of IT and business strategies is underscored, enhancing strategy formulation by identifying areas for improvement ("*Understanding the maturity of our capabilities enables us to identify the specific areas in which we need to improve"*). Integration challenges within the data domain involve establishing connections and a common meta model (*"The challenges revolve around the approach and establishing the connections between the elements")*. Effective governance and stakeholder engagement are crucial, supported by designated roles and emphasizing individual benefits *"Having a governance structure is crucial for ensuring successful integration with designated bodies and individuals with specific*

roles" and "By emphasizing the individual benefits of enterprise architecture... stakeholders see the value and are more willing to contribute". Ultimately, success is measured by streamlining IT landscapes, eliminating legacy systems, and having comprehensive business and functional requirements *"The goal is to create a more streamlined and homogeneous IT environment" and "The availability of comprehensive business and functional requirements contributes to informed decision-making"*. The importance of foundational elements like a well-defined metamodel and data integration is highlighted: *"Integration means ensuring that data is connected and interrelated guides the integration process".* Lastly, the role of theoretical understanding is stressed in paving the way for practical implementation: *"Theoretical understanding provides the necessary foundation for a comprehensive and effective enterprise architecture approach".*

5.2 Case study

The EP plays a vital role in shaping EU policies and decisions, making EA integration a critical consideration for optimizing its operations and achieving strategic goals. The study was conducted within the organizational framework of the European Parliament, which operates under a unified Enterprise Architecture encompassing various departments. To gain a comprehensive understanding, we will focus on two key departments within the EP, namely the Directorate-General for Translation (DG-TRAD) and the Directorate-General for Finance (DG-FINS).

The European Parliament's expansive structure consists of various departments and functions, each contributing to the overall efficiency and effectiveness of the organization. DG-TRAD's primary responsibility is to provide high-quality translation services, ensuring effective communication and linguistic diversity within the EU. On the other hand, DG-FINS plays a pivotal role in financial management and budget execution, overseeing the allocation and utilization of financial resources for the EP's activities. As part of our investigation, we will utilize the Capability Map, a fundamental component of EA, to analyze and visualize the EP's capabilities. By focusing on the Budget Execution capability, we aim to gain insights into the financial

processes and decision-making that drive the EP's financial management and resource allocation practices.

Through comprehensive interviews and an extensive review of existing literature, we seek to identify the expected benefits, challenges, and success factors associated with integrating EA within the public sector, with a particular emphasis on DG-TRAD and DG-FINS. By understanding the intricacies of these departments' operations and the impact of EA integration, we aim to uncover valuable lessons that can inform other public sector organizations seeking to embark on a similar journey.

As part of the analytical process, a deliberate decision was made to extract the budget execution component from the overarching Enterprise Architecture diagram that spanned the entire organization. This strategic isolation served a specific purpose: to conduct a meticulous examination of the unique operational characteristics present in different departments. By isolating the budget execution component, the goal was to gain an in-depth understanding of the specific processes, functions, and interrelations associated with this critical capability.

This isolation process facilitated a targeted exploration of how individual departments executed the budget capability, shedding light on the intricacies embedded in their distinctive operational methodologies. It provided the means to delve into the finer aspects of budget execution, unveiling the intricacies, challenges, and competencies inherent in the approach of each department. This method mirrored a process of peeling back layers, exposing the fundamental mechanisms that underpinned each department's budget execution strategy.

The principal aim of this strategic isolation was to identify commonalities and deviations across departments. Through this analytical lens, the objective was to uncover potential areas of alignment that could be harnessed to establish a unified and optimized approach to budget execution. By comprehending how diverse departments engaged with this capability, the groundwork was laid for formulating a comprehensive integration strategy.

In essence, the isolation of the budget execution component paralleled the creation of a microscope, offering an amplified view into the intricate mechanisms steering each department's operational tactics. This procedural step played an instrumental role in setting the stage for subsequent phases of integration, where shared patterns and collaborative procedures could be strategically employed to enhance operational efficiency and promote cohesive actions across the organizational landscape.

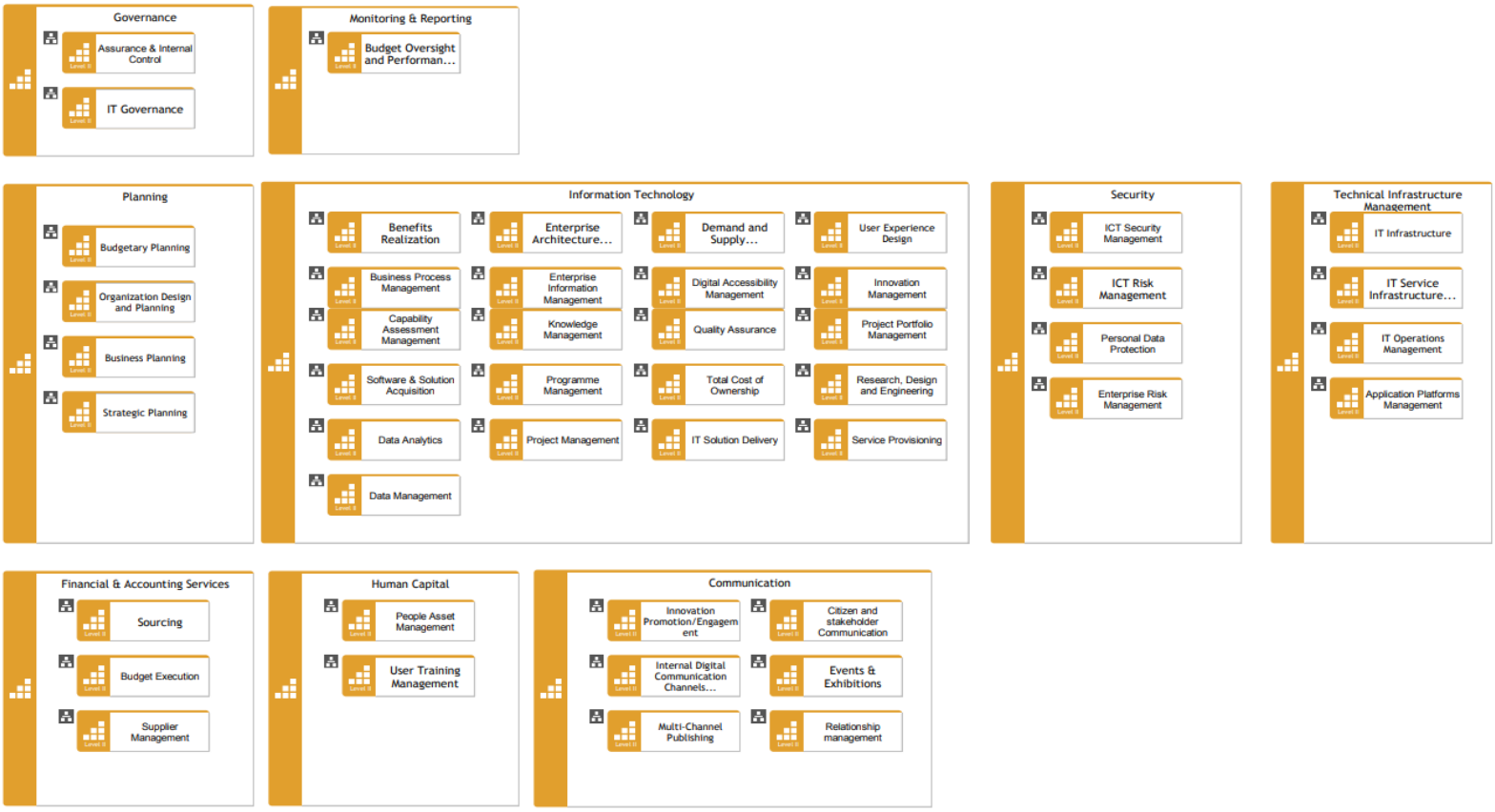

Figure 5.2: *Capability map of European Parliament*

Upon examining the detailed ArchiMate diagram focused on budget execution, a notable finding emerged. Despite being distinct units—DG-FINS and DG-TRAD—it was evident that they shared quite a few similar processes. This suggests that these units could work together more effectively.

This discovery implies that there's a chance for collaboration and smoother operations. It's like discovering a common thread where both units can join forces and avoid duplicating efforts. This realization opens the door to the possibility of pooling resources, saving time, and achieving better outcomes.

Before embarking on the task of integrating models, a crucial prerequisite demanded immediate attention – the need to establish a consistent and standardized language structure for diagrammatic representations within the European Parliament. The existing diagrams suffered from a lack of adherence to clearly defined modeling principles, resulting in unclear relationship depictions and compromised clarity. Addressing this challenge was paramount, and thus a fundamental step was taken: a comprehensive process of remodeling the diagrams to align with the well-established ArchiMate language guidelines. This undertaking entailed close collaboration with stakeholders from the European Parliament to ensure a precise grasp of the required structural elements.

This process of refinement involved hands-on engagement with the existing models. It encompassed meticulous adjustments to the representations, the redefinition of relationships, and the infusion of explicit language constructs consistent with ArchiMate. The objective was twofold – enhancing visual clarity and bolstering the diagrams' effectiveness in conveying intricate interconnections. This effort not only set the stage for coherent integration but also fostered a deeper understanding of the organizational nuances.

Central to the success of this endeavor was a continuous dialogue with key individuals within the European Parliament. Regular consultations were instrumental in validating the accurate interpretation of essential elements and aligning the model's portrayal with the actual organizational structure and operational processes. This collaborative approach acted as a bridge between theoretical modeling principles and the pragmatic realities of the European Parliament.

In essence, the initial phase of this research was dedicated to the meticulous transformation of diagrammatic representations, molding them into a language that adhered meticulously to ArchiMate conventions. This transformation stood as the cornerstone for subsequent integration efforts, facilitating a smoother application of integration methods. Additionally, this process underscored the critical significance of effective communication and collaboration with organizational stakeholders, accentuating the pivotal role of contextual comprehension in steering model refinements.

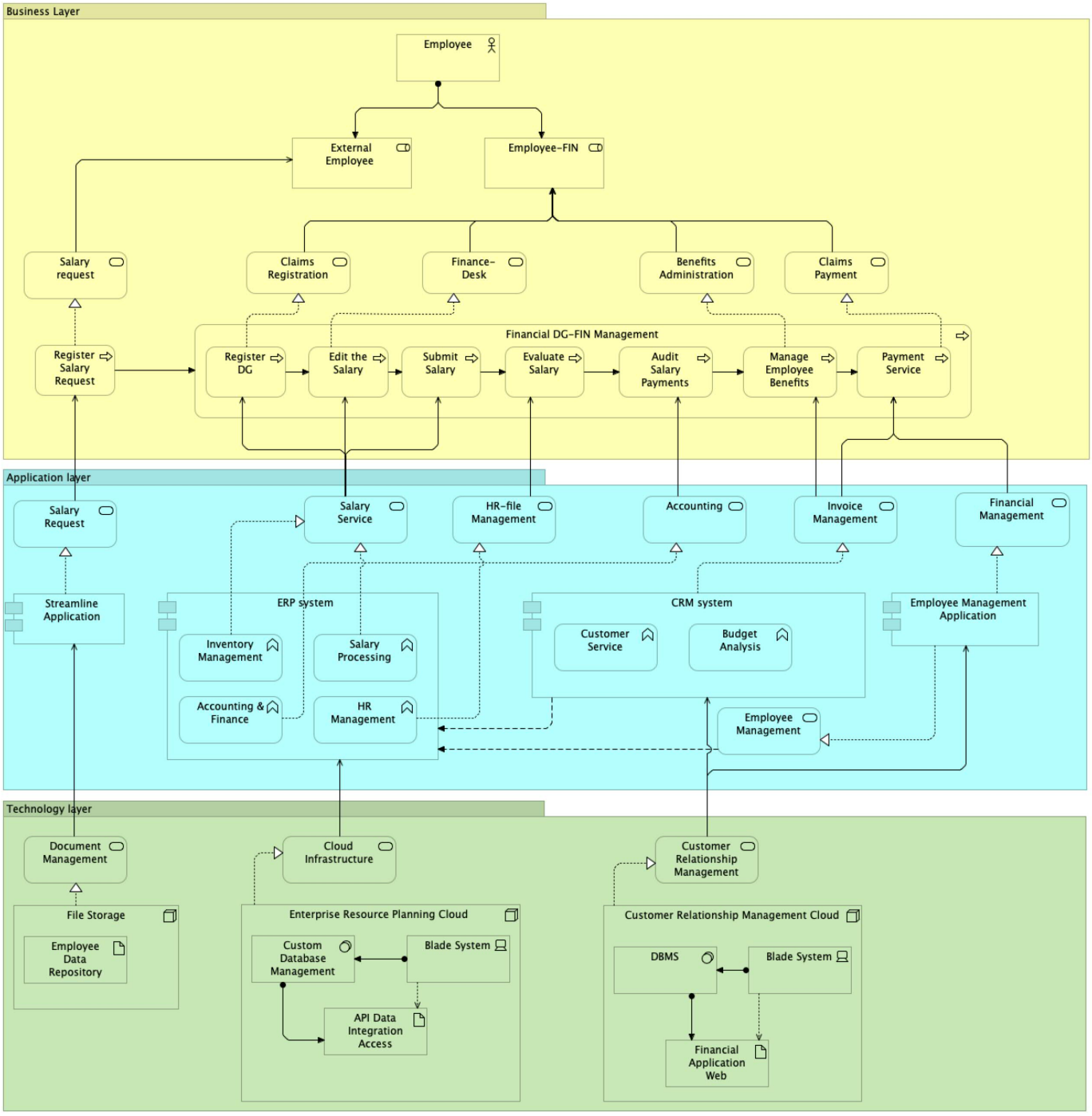

Figure 5.3: *Budget execution Finance Department ArchiMate model*

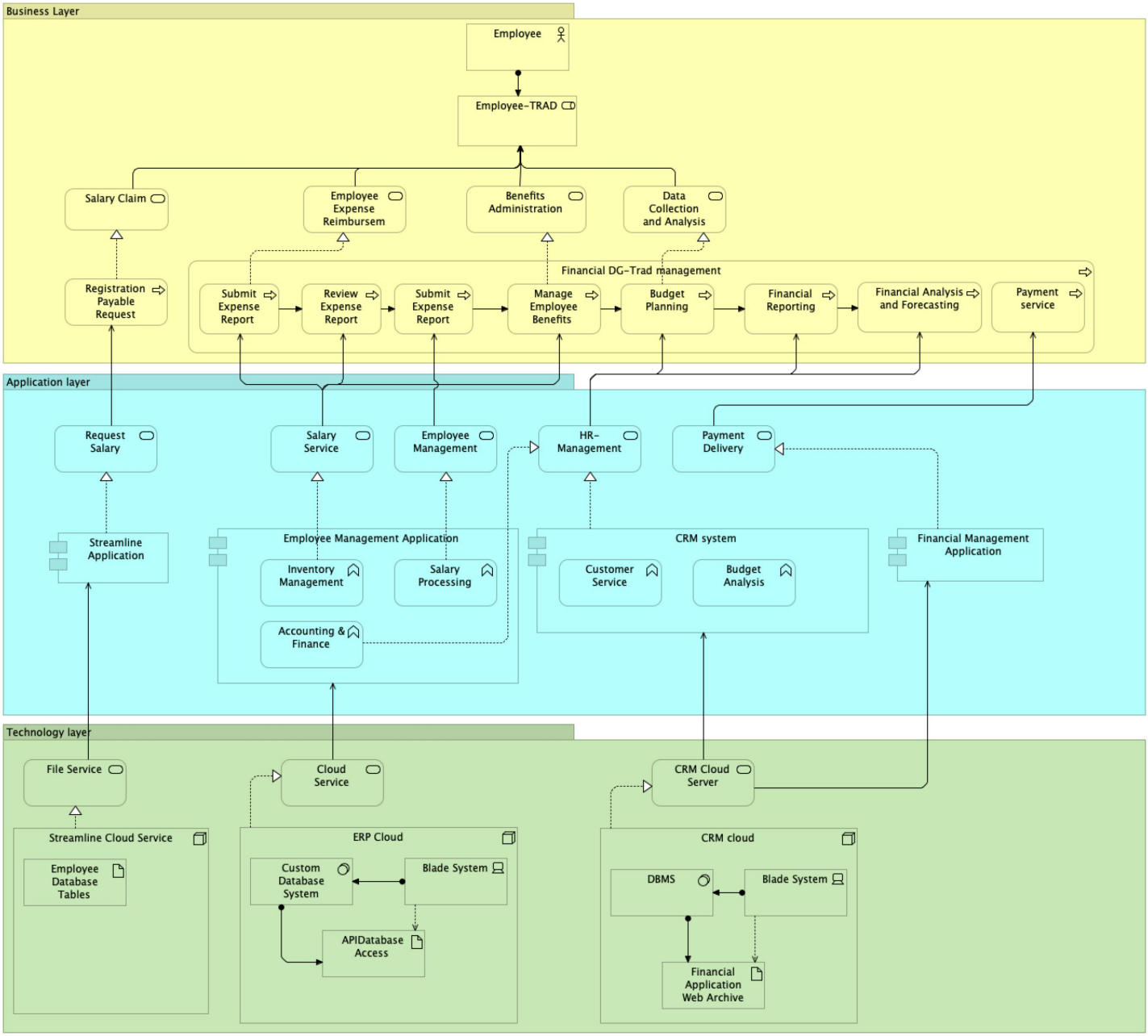

Figure 5.4: *Budget execution Translations Department ArchiMate model*

Execution of integration design patterns

To facilitate seamless integration, we have employed well-established design patterns and proven solutions to common architectural challenges. These patterns offer a structured and efficient approach to aligning the capabilities of DG-TRAD and DG-FINS, ensuring a smooth and effective integration process.

The findings of our study hold strategic significance for EA integration in the public sector, offering valuable insights to the EP and other public organizations grappling with similar integration endeavors. By optimizing resources, fostering collaboration, and streamlining processes, the merged ArchiMate model presents a promising solution for enhancing the EP's overall performance and effectiveness.

In our pursuit of achieving seamless integration between DG-TRAD and DG-FINS, we strategically employed several well-established design patterns, each contributing to resolving specific architectural challenges while maintaining efficiency and structure. These design patterns were applied across different layers of the architectural diagrams to ensure a cohesive approach to integration.

Application Consolidation Pattern

The concept of application consolidation serves as a strategic enabler for optimizing the architecture by identifying and eliminating redundancies while integrating applications. In the context of the DG-Finance and DG-TRAD diagrams, it's evident that certain functions overlap. The implementation of the application consolidation pattern involves the following stages:

Identification of Overlapping Functions: Upon careful examination of the diagrams, it becomes apparent that Employee-Fin and Employee-Trad necessitate similar business services such as Employee Expenses Reimbursement, Benefits Administration, and Salary Claim see ***Figure 5.5:*** *Application Consolidation Translations department* and ***Figure 5.6:*** *Application Consolidation Finance Department*.

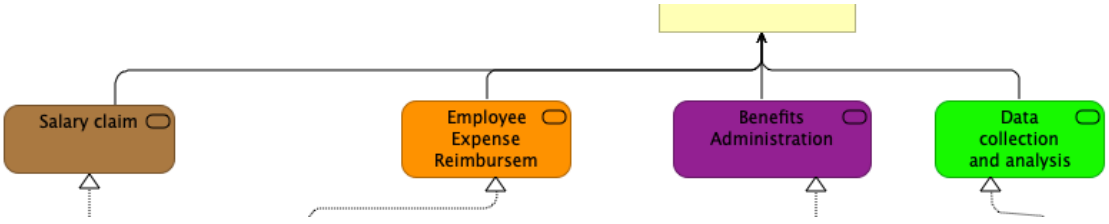

Figure 5.5: *Application Consolidation Translations department*

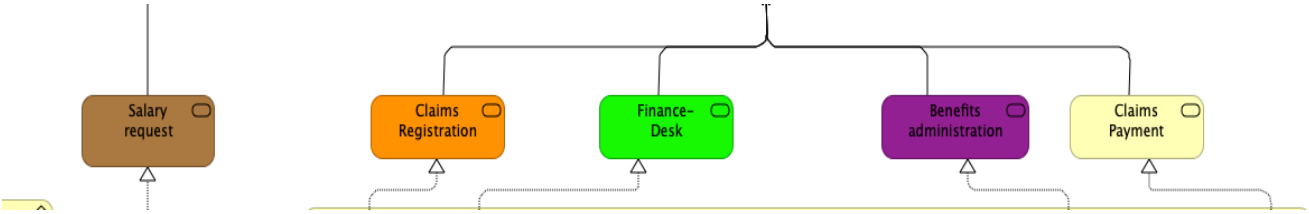

Figure 5.6: *Application Consolidation Finance Department*

Decision to Consolidate: To enhance efficiency and reduce complexity, a decision is taken to consolidate these similar functions into a unified set. This approach not only eliminates redundancy but also optimizes maintenance efforts.

Unified Business Services: In response to the consolidation decision, the separate services like Expenses Reimbursement, Benefits Administration, and Salary Claim are integrated into cohesive Business Services. These services now cater to both Employee-Fin and Employee-Trad, avoiding duplication see ***Figure 5.12:*** *Final diagram after patterns implication*.

Alignment of Business Processes: Corresponding business processes are realigned to the consolidated services. For example, the Finance DG-TRAD Management and Finance DG-Fin Management processes are combined into a comprehensive process that manages actions like Submit Salary Request, Edit the Salary, Review Financial Claim, and others. It was observed that the "Submit Salary Expense Report" process in DG-TRAD shares striking similarities with several processes in DG-Finance, including "Register DG," "Submit the Salary," and "Audit Salary Payments." This overlap indicated a common purpose and underlying functionalities that span both departments. To make these overlaps visually evident, a strategic approach was employed. The overlapping processes, where "Submit Salary Expense Report" aligns with "Register DG," "Submit the Salary," and "Audit Salary Payments," were highlighted with a distinctive red color. This color-coded representation serves as a visual marker, simplifying the identification of processes that collectively fulfill a shared objective. It was also observed that the "Manage Employee Benefits" process and the "Payment Services" process in both departments bear similar functionalities. In a concerted effort to enhance clarity, these overlapping processes were designated distinct colors: the

overlaps tied to "Submit Salary Expense Report" were marked in red, while those linked to "Manage Employee Benefits" and "Payment Services" were identified with shades of blue and pink, respectively.

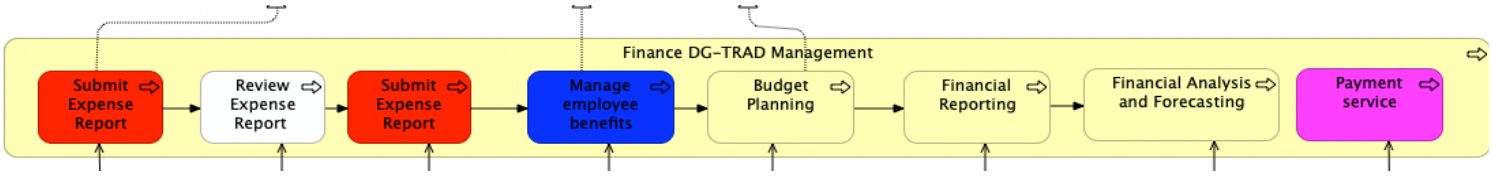

Figure 5.7: *Application Consolidation DG-TRAD Department Business Processess*

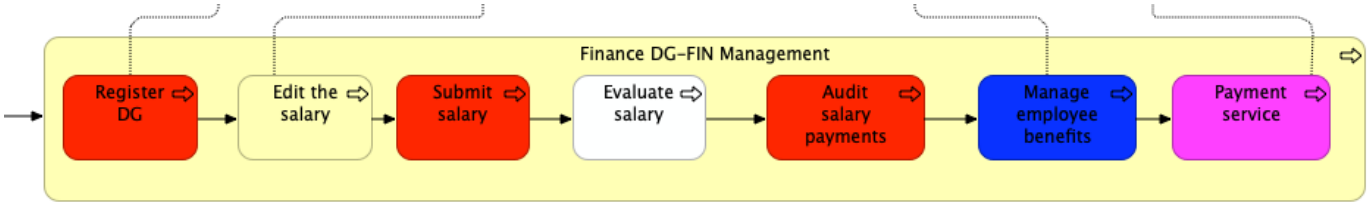

Figure 5.8: *Application Consolidation DG-FIN Department Business Processes*

Streamlined Application Landscape: In the integrated diagram, applications that performed similar functions in the initial setup are streamlined. For instance, instead of having separate ERP systems for different departments, a single ERP application component is employed to handle common functions like Inventory Management, Salary Processing, and more.

By employing the application consolidation pattern, it ensures a more efficient and manageable architecture but also pave the way for optimal resource utilization and enhanced operational effectiveness.

Realization Alignment

Realization alignment is a pivotal aspect of Enterprise Architecture, ensuring that applications and services are harmoniously matched with corresponding business processes. The application of this pattern is crucial for achieving a seamless integration of the DG-Finance and DG-TRAD diagrams. The process is executed as follows:

Mapping Business Services to Unified Business Functions: Both initial diagrams feature distinct realizations of business services such as Expenses Reimbursement and Benefits Administration. In the integrated diagram, these individual realizations are aligned with a singular, all-encompassing business function. This alignment eliminates redundancy and establishes a coherent operational structure.

Integration of Application Services with Unified Business Processes: Parallel to the preceding step, the application services like Salary Service, HR File Management, and Financial Management undergo realignment to synchronize with the unified business processes. For instance, the Salary Service application service is seamlessly integrated with the Submit Salary Request business process. This alignment not only enhances process efficiency but also ensures a logical coherence between business requirements and technological implementations. Two indispensable application services, "Salary Service" and "HR File Management," resonated seamlessly across both departments. The strategic consolidation was further witnessed with the integration of "Employee Management" and "Payment Delivery" from DG-TRAD and "Invoice Management" and "Financial Management" from DG-Finance. The result was a cohesive integration, symbolized by the distinctive brown and orange-colored segments within your unified architecture.

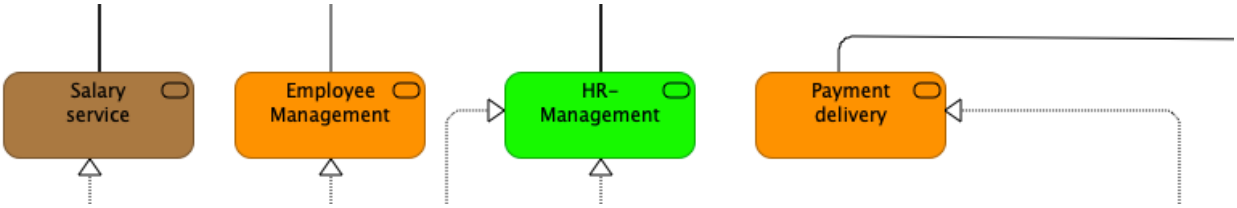

Figure 5.9: *Realization Alignment DG-TRAD Department Application Service*

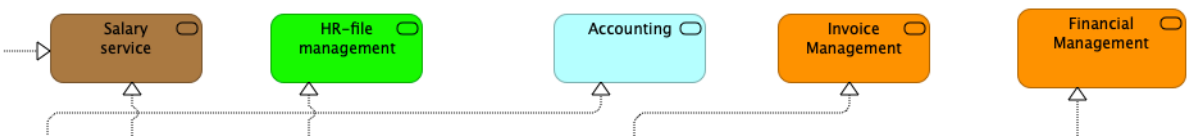

Figure 5.10: *Realization Alignment DG-FIN Department Application Service*

Harmonizing Realizations: The integrated diagram reflects a refined realization alignment, where business functions, processes, and application services interact seamlessly, supporting a comprehensive and unified architecture. This alignment assures that every element of the architecture contributes directly to the realization of overarching business objectives.

By diligently applying the realization alignment pattern, the architecture gains a robust foundation for optimized operations, reduced complexities, and streamlined interplay between business and technological realms.

Function Consolidation

Function consolidation serves as a strategic approach to unify similar business functions, enhancing operational coherence and optimizing resource utilization. The application of this pattern is essential for achieving a harmonized architecture. Here's how this pattern is thoughtfully employed:

Identifying Common Business Functions: A meticulous examination of both the DG-Finance and DG-TRAD diagrams uncovers the presence of comparable business functions such as Benefits Administration, Expenses Reimbursement, and Salary Claim. Despite serving distinct employee categories, these functions share underlying processes and objectives.

Merging Parallel Business Functions: The essence of function consolidation lies in merging these parallel business functions into a singular, comprehensive entity. By amalgamating the Benefits Administration, Expenses Reimbursement, and Salary Claim functions, you create a unified structure that eliminates duplications and redundancies.

Alignment with Business Services: With the consolidated function in place, the next step is to align it strategically with relevant business services. This alignment ensures that the services appropriately cover the needs of both Employee-Fin and Employee-Trad. For instance, the unified business function encapsulates the functionalities of managing expenses, claims, and benefits. This consolidated function is then seamlessly

associated with business services such as Financial Management and HR File Management.

Operational Synergy: Function consolidation contributes significantly to operational synergy. By consolidating similar business functions, your architecture streamlines processes, minimizes the risk of inconsistencies, and optimizes resource allocation. This ensures that the architecture functions as a cohesive unit, supporting diverse employee roles while avoiding the pitfalls of duplicative efforts.

By adeptly implementing the function consolidation pattern, the architecture attains enhanced efficiency, reduced redundancy, and an optimized use of resources. The alignment of business functions with services fosters a seamless operational landscape, ensuring that every element within the architecture is in sync with the overarching business objectives.

Middleware Design Pattern

The Middleware Design Pattern was employed in the final merged diagram to enable seamless communication and interaction between different application components and services. Specifically, the "Middleware" component serves as an intermediary, facilitating communication between "SI-CRM Interface" and "CRM-SI Interface," streamlining applications, and CRM systems. This pattern ensures efficient data exchange, minimizes direct dependencies between components, and enhances system flexibility.

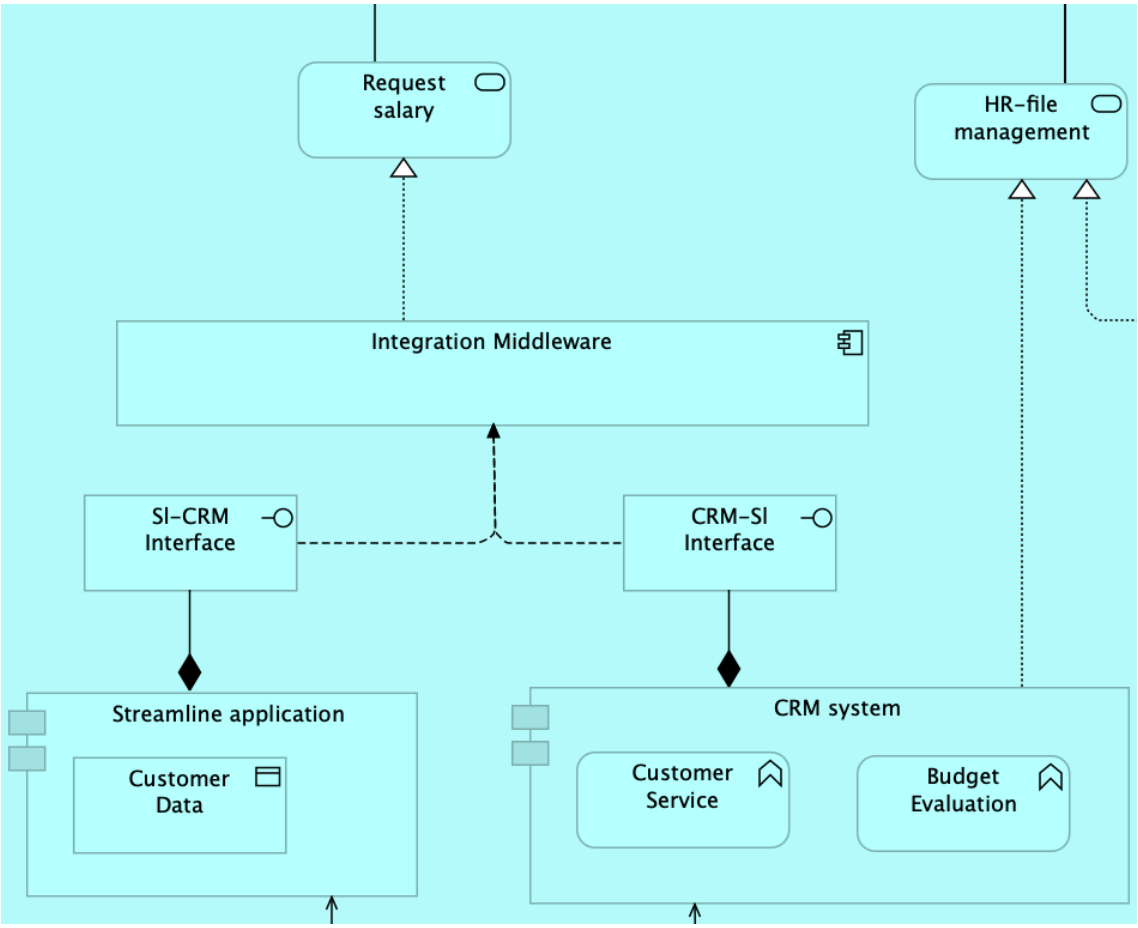

Figure 5.11: *Middleware design pattern practical implication*

In summary, the Application Consolidation Pattern was used to merge similar business services, Realization Alignment ensured correspondence between business and application services, Function Consolidation streamlined application functions, and the Middleware Design Pattern facilitated efficient component communication. Through these strategic design pattern applications, we systematically addressed integration challenges and fostered a harmonious and effective alignment of DG-TRAD and DG-FINS capabilities.

As the culmination of our integration efforts, the final diagram encapsulates the essence of the harmonious alignment between DG-TRAD and DG-FINS capabilities. This diagram stands as a visual representation of the strategic application of design patterns, the meticulous consideration of architectural elements, and the pursuit of optimal efficiency and cohesion. It portrays an integrated landscape where diverse business

functions seamlessly interact with their corresponding technical counterparts, creating a unified ecosystem that transcends organizational boundaries. Let us delve into this comprehensive depiction, exploring the intricacies and symbiotic relationships that underscore the successful integration of these two distinct domains.

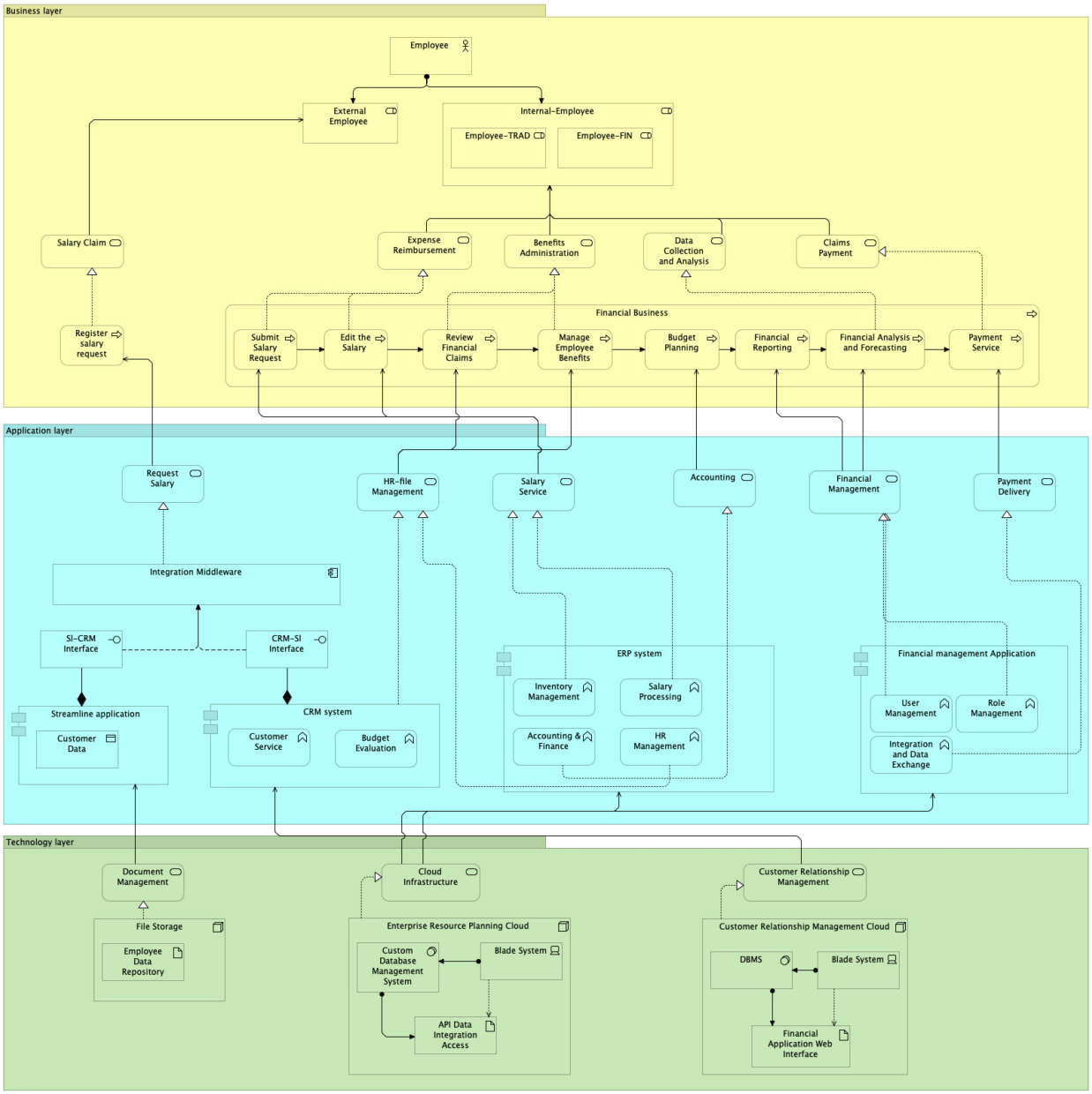

Figure 5.12: *Final diagram after patterns implication*

As the culmination of our integration efforts, the final diagram encapsulates the essence of the harmonious alignment between DG-TRAD and DG-FINS capabilities. This

diagram stands as a visual representation of the strategic application of design patterns, the meticulous consideration of architectural elements, and the pursuit of optimal efficiency and cohesion. It portrays an integrated landscape where diverse business functions seamlessly interact with their corresponding technical counterparts, creating a unified ecosystem that transcends organizational boundaries.

5.3 Validation

5.3.1 Validation Approach

Validating the integrated architecture was a crucial step to ensuring that proposed integration strategies were not just theoretical concepts but practical solutions. We achieved this by directly engaging with professionals from DG-TRAD and DG-FINS within the European Parliament. Face-to-face discussions allowed us to present the integrated architecture and have meaningful conversations with experts who understand the day-to-day intricacies of their domains.

Three important stakeholders were involved in the validation process: a professional business analyst and two highly experienced senior enterprise architects. Initially, the senior architects examined the remodeled DG-TRAD (see ***Figure 5.4:*** *Budget execution Translations Department ArchiMate model*) and DG-FINS (see ***Figure 5.3:*** *Budget execution Finance Department ArchiMate model*) diagram. to ensure that all parts were appropriately represented and aligned with the anticipated integration objectives.

Following that, the integrated diagram (see ***Figure 5.12:*** *Final diagram after patterns implication*) was extensively examined by the same group of stakeholders. The senior architects went over the ArchiMate models again, making sure that all components were correctly set, integrated, and servicing the needs of both departments.

In the section **5.3.3 Validation Results** the points underscored the practical relevance and effectiveness of our integrated architecture within the European Parliament's

operational landscape. The validation results were derived from feedback provided by two Senior Enterprise Architects.

5.3.2 Insights from Direct Discussions

The in-person discussions provided us with important insights that confirmed the value of our integration efforts. The professionals from DG-TRAD and DG-FINS appreciated how the integrated architecture accurately mirrored their actual work processes. They found the design patterns to be particularly useful and applicable to their real-world situations. The application consolidation pattern, which streamlined overlapping business functions, and the middleware design pattern, which facilitated smooth data exchange, were particularly well-received.

5.3.3 Validation Results

Our validation process yielded several significant outcomes that emphasize the practicality and feasibility of our integrated architecture:

Harmonized Operations: The professionals confirmed that our integrated architecture effectively unified their processes and functions. This validation showed that the architecture could bridge functional gaps and enhance overall efficiency.

Practical Design Patterns: The participants recognized that our application of design patterns greatly simplified the integration process. They found application consolidation, realization alignment, function consolidation, and middleware design patterns instrumental in achieving a coherent integration.

Realistic Representation: The experts affirmed that our integrated architecture accurately reflected their everyday work environment. The alignment of business services, processes, and application components with their real-world counterparts was particularly noteworthy.

Improved Collaboration: The validation discussions encouraged collaboration among professionals from different areas, fostering better communication and shared understanding. The architecture provided a common language and visual representation that facilitated effective interactions.

Strategic Alignment: The participants understood the strategic importance of the integrated architecture in connecting DG-TRAD and DG-FINS with broader organizational goals. The architecture's ability to reflect these priorities was acknowledged.

6 Discussion

This chapter will go into great detail about this research. It opens with a summary of the key findings from the study. The study's research questions will then be briefly discussed after that. Finally, the internal and external boundaries of the study as well as prospective directions for future research will be examined.

6.1 Summary of key findings

This section presents the outcomes of our research, a culmination of insights drawn from interviews and an extensive case study exploring the integration of Enterprise Architecture (EA) within two departments of the European Parliament. Our primary objective was to uncover opportunities for EA integration, streamline processes, and optimize resource utilization to bolster budget execution efficiency.
The research journey commenced with in-depth interviews with key stakeholders, domain experts, and IT specialists hailing from various departments within the European Parliament's IT division. These interviews aimed to comprehend existing challenges, complexities, and potential areas for improvement concerning budget execution capability. The insights gleaned from these conversations laid the groundwork for our subsequent case study, providing a comprehensive foundation rooted in diverse departmental perspectives.

The case study delved into the architectural landscapes of two distinct departments, DG-TRAD and DG-FINS, both integral to budget execution within the public sector. The study revealed considerable overlaps and redundancies in their ArchiMate diagrams. Recognizing room for improvement and cost-saving potential, we pursued the merger of these diagrams. This merger aimed to eradicate redundancies, stimulate collaboration, and align business and IT strategies across the departments. Our integration approach was honed through consultations with domain experts, IT specialists, and stakeholders from both departments, enhancing its effectiveness and validity.

The empirical findings in this section are presented through insights garnered from interviews and the integrated ArchiMate diagram. This integrated approach provides a

comprehensive understanding of the challenges and anticipated outcomes related to the integration of EA within public sector budget execution.

Our research provides strategic insights for public sector entities seeking to harness the power of EA in optimizing budget execution, augmenting operational efficiency, and delivering enhanced public services. The combination of interview data and a case study furnishes a robust foundation for informed decision-making and successful EA integration endeavors in public sector budget execution contexts.

The interview findings in **Section 5.1** underscore the impact of EA on the European Parliament. High-impact factors include improved collaboration, decision-making, complexity management, breaking down silos, stakeholder engagement, and alignment of business and IT strategies. Medium-impact elements encompass resource allocation, governance, and framework selection. Low-impact factors include cultural factors, assessing EA readiness, and customizing EA methodologies.
In **Section 5.2** the case study revealed substantial capability overlaps between DG-TRAD and DG-FINS. By proposing a unified ArchiMate model, we aimed to streamline processes, eliminate redundancies, and optimize resource utilization. The application of design patterns, such as Application Consolidation, Realization Alignment, Function Consolidation, and Middleware Design patterns, strategically tackled integration challenges.

In the validation phase, **Section 5.3**, in-person discussions with professionals validated the feasibility and practicality of our integrated architecture. Feedback emphasized the architecture's alignment with real-world processes, the effectiveness of design patterns, and improved collaboration and alignment with organizational goals.
Overall, this chapter contributes an in-depth exploration of the integration of EA within the European Parliament's departments, offering valuable insights and practical implications for public sector organizations aiming to enhance their budget execution processes through EA integration.

Another significant outcome of this research is the development of a comprehensive method for addressing Enterprise Architecture (EA) integration challenges within the public sector. This method is not just theoretical; it has been rigorously tested and successfully applied in practice, as demonstrated by its practical implementation in the integration of two departments within the European Parliament. This achievement underscores the method's viability as a practical solution for other public sector organizations seeking to enhance their budget execution processes through EA integration. It serves as a valuable blueprint for implementing similar integration initiatives and streamlining operations while optimizing resource utilization. This methodological approach ensures that EA integration is not merely a conceptual ideal but a tangible, real-world solution with proven effectiveness.

6.2 Research Questions

This section aims to address the research questions (RQs) that guide our investigation into the integration of Enterprise Architecture (EA) within the European Parliament as a governmental organization. The overarching research question serves as a central anchor for our study, while the sub-questions provide a structured approach to comprehensively addressing the main inquiry.

Sub-Research Questions

To elucidate the main research question and offer a holistic perspective, a set of sub-research questions was formulated. These sub-questions intricately contribute to the exploration of the main inquiry and provide a structured framework for investigation.

RQ1.1: What are the expected benefits of integrating Enterprise Architecture within public sector organizations, specifically within the European Parliament?
This sub-question endeavors to uncover the potential advantages that EA integration offers to governmental bodies, shedding light on the positive outcomes that can result from aligning organizational structures, processes, and technologies.

In Section **2.1.2 Benefits of Enterprise Architecture** provides a more thorough description of the advantages of enterprise architecture and covers a variety of its aspects.

RQ1.2: What are the challenges, and best practices for integrating EA into the Public Sector?
This sub-question delves into the complexities and obstacles that arise when integrating EA into government organizations. It also seeks to identify best practices that can facilitate a smoother integration process.

In sections **2.1.4 Frameworks** and **2.1.5 Design Patterns** of this thesis, in-depth descriptions of Enterprise Architecture issues and best practices have been provided, as well as coverage of several areas of Enterprise Architecture..

RQ1.3: How can the European Parliament practically implement EA integration methods within the two departments under study?

This sub-question focuses on the practical application of EA integration within the European Parliament. By examining two specific departments, Directorate-General for Translation (DG-TRAD) and Directorate-General for Finance (DG-FINS), we aim to provide actionable insights into the implementation process.
The implementation of the EA integration has been described in detail in Chapter **5 Results**

Answer: Through a comprehensive exploration combining interviews, case studies, and validation with key stakeholders, this study has unveiled critical insights into the integration of Enterprise Architecture (EA) within the European Parliament. The journey to effectively integrate EA involves a strategic amalgamation of alignment, design patterns, and stakeholder engagement.

Our findings reveal that EA integration within the European Parliament yields substantial benefits. Improved collaboration, informed decision-making, efficient

complexity management, and the dismantling of silo mentality emerge as key advantages. The application of design patterns, such as Application Consolidation, Realization Alignment, Function Consolidation, and Middleware Design patterns, emerged as proven strategies to address integration challenges and foster cohesion.

Practical implementation necessitates a meticulous transformation of existing diagrams to adhere to ArchiMate language guidelines. This remodeling lays the groundwork for a seamless integration process. The validation phase, involving direct interactions with DG-TRAD and DG-FINS professionals, reinforces the practicality and significance of the integrated architecture. This engagement validated the real-world relevance of design patterns and the architecture's accurate representation of organizational processes.

In a broader context, the insights derived from the European Parliament case study bear implications for the wider public sector. The integration methods, design patterns, and strategic alignment principles can be adapted and applied to governmental entities seeking enhanced operational efficiency and effectiveness through EA integration.

RQ1.4: How can the lessons learned from the European Parliament's case be generalized for a broader application of EA integration in the public sector?
This sub-question transcends the specific case study and seeks to distill universal insights from the European Parliament's experience. By considering the broader context of the public sector context, this sub-question explores the transferability of integration methods and strategies.

Main Research Question

The main research question that underlies this study is:

RQ1: How can the European Parliament, as a governmental organization, effectively navigate the process of integrating Enterprise Architecture?

Answer to RQ1: The integration of Enterprise Architecture within the European Parliament involves a multifaceted approach that combines strategic alignment, systematic design patterns, and stakeholder collaboration. Through a comprehensive investigation encompassing interviews, a detailed case study, and validation with professionals from the Directorate-General for Translation (DG-TRAD) and Directorate-General for Finance (DG-FINS), we uncover that successful EA integration hinges on several key principles.

Firstly, the expected benefits of EA integration within the public sector, particularly in the European Parliament, include enhanced collaboration, improved decision-making, effective complexity management, breaking down silo mentality, and streamlined stakeholder engagement. The systematic application of design patterns such as Application Consolidation, Realization Alignment, Function Consolidation, and Middleware Design patterns facilitates the alignment of business and IT strategies, resource optimization, and improved communication. These patterns provide practical solutions to the challenges associated with integration.

In terms of practical implementation, our study reveals that the integration of EA requires the careful remodeling of existing diagrams to adhere to well-established language guidelines, in this case, ArchiMate. A collaborative dialogue with key stakeholders ensures that the model accurately reflects the organization's processes and needs. This remodeling sets the foundation for a coherent integration process.

Our validation approach, involving direct discussions with professionals from DG-TRAD and DG-FINS, confirms the practicality and value of the integrated architecture. Insights from these discussions underscore the real-world relevance of design patterns and the architecture's accurate representation of organizational processes.

In a broader context, the lessons learned from the European Parliament's case study can be generalized to other public-sector organizations seeking to integrate EA. The integration methods, strategic alignment, and design patterns presented in our study

offer insights that can be adapted and applied to various governmental bodies aiming to optimize their operations through effective EA integration.

In conclusion, addressing the main research question highlights that the effective integration of Enterprise Architecture in the European Parliament necessitates strategic alignment, systematic design pattern application, and close collaboration with stakeholders. The insights gained from this research contribute to guiding other public sector organizations on a successful journey of EA integration, ultimately enhancing their operational efficiency and effectiveness.

6.3 Reflection

The European Parliament, the study's focus, demonstrated variances in EA adoption throughout its organizational parts. This emphasized the need to encourage joint efforts to maximize the benefits of EA.

Language inconsistencies created difficulties throughout our inquiry. The usage of diverse terminologies in discussing EA underscored the importance of developing a consistent and generally understood language to enable effective communication among stakeholders.

A significant pattern emerged, with clear gaps in the implementation of EA across various sectors within the Parliament. This highlighted the critical lesson that the full potential of EA can only be realized through consistent and uniform use across all organizational areas.

The usage of detailed diagrams proved difficult. It became clear that employing clear and understandable visual representations is critical in clarifying the complexities of EA to stakeholders and establishing a collective awareness of its operational mechanisms.

Engaging with members of the organization produced surprising results. A prevalent mood evolved in which tailoring EA to the unique requirements of the European Parliament was not universally regarded as a top priority. This remark emphasized the importance of achieving a healthy balance between EA competencies and alignment with larger company objectives.

In conclusion, this thesis went beyond theory and provided practical insights on integrating EA inside a complex institution. It acts as a guide, tracing the road through the problems and opportunities of EA integration. It is also important to remember that effective use of EA requires a collaborative effort, clear communication, and a shared perspective among all stakeholders.

7 Conclusion

In the modern realm of public sector organizations, the integration of Enterprise Architecture (EA) emerges as a vital catalyst for efficiency, alignment, and strategic transformation. This thesis embarked on a journey to explore the integration of EA within the European Parliament, unveiling insights, challenges, and best practices that pave the way to informed implementation.

The research began with an examination of the underlying concepts of EA, providing clarity regarding its importance in bridging the gap between IT and business strategy. Through a meticulous analysis of literature and real-world cases, the study highlighted the multifaceted advantages of EA, spanning from enhanced decision-making to streamlined operations and enriched collaboration.

Guided by a comprehensive research framework, the empirical phase of this study unfolded. In-depth interviews with professionals deeply involved in the integration of EA within the European Parliament illuminated the practical implications of EA integration. These insights, coupled with an exhaustive analysis of ArchiMate diagrams, demonstrated the remarkable potential of a well-structured and cohesive EA framework.

The case study of the Directorate-General for Translation (DG-TRAD) and the Directorate-General for Finance (DG-FINS) offered a vivid portrayal of the integration journey. The application of design patterns, realization alignment, and function consolidation showcased the strategic integration process. Furthermore, the validation phase corroborated the effectiveness of the integration strategies through direct interactions with experts from the European Parliament.

However, the journey was not devoid of challenges. The lack of standardized ArchiMate diagrams, inconsistent adherence to language patterns, and the presence of siloed approaches underscored the need for comprehensive organizational alignment. The lessons drawn from this case hold universal relevance. For broader applicability in the public sector, a holistic approach demands commitment across all departments,

adherence to standardized frameworks, and the diligent cultivation of a collaborative culture.

In conclusion, this thesis elucidates the intricate tapestry of EA integration within the public sector. The European Parliament's experience serves as both a beacon of inspiration and a repository of lessons. As public sector organizations strive for heightened efficiency and strategic innovation, the integration of Enterprise Architecture emerges as a dynamic catalyst, transcending challenges and carving pathways to excellence. In this transformative landscape, the integration of EA holds the promise of reshaping the contours of public administration, leading to more effective and responsive governance.

7.1 Limitations and Future Work

7.1.1 Limitations

While this research has provided valuable insights into the integration of Enterprise Architecture (EA) within the European Parliament, there are certain limitations that should be acknowledged:

1. ArchiMate Diagram Quality: One notable limitation is the quality of the ArchiMate diagrams used within the European Parliament. The existing diagrams lacked adherence to the standard language patterns of ArchiMate, leading to unclear relationship depictions and compromised clarity. This limitation posed challenges during the integration process, necessitating a substantial effort to remodel the diagrams and align them with ArchiMate language guidelines.

2. Inconsistent Language Patterns: A related limitation pertains to the inconsistent use of language patterns within the ArchiMate diagrams. The lack of adherence to standard language constructs hindered the accurate interpretation of diagrams and impeded the integration process. This highlights the importance of adopting and

consistently following a standardized language pattern to ensure effective communication and clarity.

3. Partial Adoption of EA: Another limitation arises from the fact that only a few departments within the European Parliament have embraced Enterprise Architecture. This limited adoption potentially restricts the scope of integration efforts and hampers the holistic benefits that comprehensive EA integration can bring. To fully leverage the potential of EA, it's essential for all departments to actively participate in and align with the integration process.

In the context of this study, it's crucial to recognize the limitations that influenced the extent and use of the discussed design patterns. Out of the seven design patterns highlighted in the literature review, only four were put into practice within the architecture. The application of these design patterns was mainly focused on the business and application layers.
However, it's worth noting that no design patterns were implemented in the technology layer. This decision was influenced by resource and time constraints. Moreover, it was determined that the current technological challenges and priorities didn't align with the scope of the Enterprise Architecture integration effort.
While the absence of design patterns in the technology layer might seem like a drawback, it was a pragmatic choice aimed at addressing immediate organizational needs. Future efforts in this area could potentially explore integrating design patterns into the technology layer for a more comprehensive solution. This approach would require reevaluating resources, timeframes, and the evolving technological landscape to determine its practicality and feasibility.

7.1.2 Future Work

While this research has provided valuable insights, there are several avenues for future work that could further enhance the understanding and application of EA integration within governmental organizations:

1. Comprehensive EA Adoption: Future research could delve into strategies for encouraging comprehensive Enterprise Architecture adoption across all departments of the European Parliament. Investigating methods to motivate departments to embrace EA could contribute to a more holistic and effective integration process.

2. Refinement of Integration Patterns: Building on the design patterns applied in this research, further investigation into the efficacy of these patterns in different contexts could be explored. Developing refined patterns that cater to specific architectural challenges within the public sector could provide valuable guidelines for future integration projects.

3. Standardized Language and Notations: Addressing the limitations related to ArchiMate diagram quality and language pattern consistency could be a focus for future research. Developing guidelines and frameworks for creating standardized diagrams that adhere to ArchiMate language constructs could improve the clarity and effectiveness of communication in architectural representations.

4. Cross-Department Collaboration: Investigating methods to enhance cross-departmental collaboration could be an area of future research. Strategies for encouraging departments to work collaboratively, share insights, and align their objectives within the context of EA integration could be explored.

5. Long-Term Impact Evaluation: Assessing the long-term impact of EA integration on the European Parliament's operations and outcomes could provide valuable insights. Future research could involve monitoring and evaluating the effectiveness of the integrated architecture over an extended period, highlighting areas of success and potential areas for improvement.

6. Generalization to Other Organizations: While this research focused on the European Parliament, the findings could be applied to other governmental organizations as well. Future work could involve conducting similar case studies in different public sector contexts to validate the generalizability of the insights gained from this research.

Bibliography

[1]. Barrat, A., Barthelemy, M., Pastor-Satorras, R., & Vespignani, A. (2004). The architecture of complex weighted networks. Proceedings of the national academy of sciences, 101(11), 3747-3752.

[2]. Guijarro, L. (2007). Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States. Government Information Quarterly, 24(1), 89-101.

[3]. Banaeianjahromi, N. (2018, May). Where enterprise architecture development fails a multiple case study of governmental organizations. In 2018 12th International Conference on Research Challenges in Information Science (RCIS) (pp. 1-9). IEEE.

[4]. Dang, D. D., & Pekkola, S. (2017). Systematic literature review on enterprise architecture in the public sector. Electronic Journal of eGovernment, 15(2), pp130-154.

[5]. Lee, Y. J., Kwon, Y. I., Shin, S., & Kim, E. J. (2013, January). Advancing government-wide Enterprise Architecture-A meta-model approach. In 2013 15th International Conference on Advanced Communications Technology (ICACT) (pp. 886-892). IEEE

[6]. Lankhorst, M. (2013). Enterprise Architecture at Work: Modelling, Communication and Analysis. Springer.

[7]. Spewak, S., & Hill, S. C. (1992). Enterprise Architecture Planning: Developing a Blueprint for Data, Applications and Technology. QED Information Sciences.

[8]. Ross, J. W., Weill, P., & Robertson, D. C. (2006). Enterprise Architecture as Strategy: Creating a Foundation for Business Execution. Harvard Business Press.

[9]. Röglinger, M., Pöppelbuß, J., & Becker, J. (2015). Maturity models for IT management – An overview and a roadmap for future research. Business & Information Systems Engineering, 57(4), 261-276.

[10]. Papazoglou, M. P., & Traverso, P. (2018). Architecting the Digital Transformation: How EA Can Help. IEEE Software, 35(1), 46-52.

[11]. Zachman, J. A. (1997). Enterprise Architecture: The Issue of the Century. Database Programming & Design, 10(2), 62-72.

[12]. Saint-Louis, P., Morency, M. C., & Lapalme, J. (2019). Examination of explicit definitions of enterprise architecture. International Journal of Engineering Business Management, 11, 1847979019866337.Erl, T. (2008). SOA: Principles of Service Design. Prentice Hall/PearsonPTR.

[13]. Zhang, J., Dawes, S. S., & Sarkis, J. (2005). Exploring stakeholders' expectations of the benefits and barriers of e-government knowledge sharing. Journal of Enterprise Information Management, 18(5), 548-567.

[14]. Olsen, D. H. (2017). Enterprise Architecture management challenges in the Norwegian health sector. Procedia computer science, 121, 637-645.

[15]. Bertino, E. (2001). Building Trustworthy Middleware Applications. IEEE Internet Computing, 5(3), 53-61.

[16]. Ghobakhloo, M., Hong, T. S., Sabouri, M. S., & Zulkifli, N. (2012). Strategies for successful information technology adoption in small and medium-sized enterprises. Information, 3(1), 36-67.

[17]. Ke, W., & Wei, K. K. (2008). Organizational culture and leadership in ERP implementation. Decision support systems, 45(2), 208-218.

[18]. Kotusev, S. (2017). Enterprise architecture: what did we study?. International Journal of Cooperative Information Systems, 26(04), 1730002

[19]. Niemi, E. (2008). Enterprise architecture benefits: Perceptions from literature and practice. Tietotekniikan tutkimusinstituutin julkaisuja, 1236-1615; 18.

[20]. Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How does enterprise architecture add value to organisations?.

[21]. Mendling, J., Strembeck, M., & Recker, J. (2012). Factors of process model comprehension—Findings from a series of experiments. Decision Support Systems, 53(1), 195-206.

[22]. DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. Journal of management information systems, 19(4), 9-30.

[23]. Tamm, T., Seddon, P. B., & Shanks, G. (2020). How do different types of BA users contribute to business value?. Communications of the Association for Information Systems, 46(1), 28.

[24]. Van de Wetering, R., Kurnia, S., & Kotusev, S. (2021). The role of enterprise architecture for digital transformations. Sustainability, 13(4), 2237.

[25]. Ahlemann, F., Legner, C., & Lux, J. (2021). A resource-based perspective of value generation through enterprise architecture management. Information & Management, 58(1), 103266.

[26]. Hugoson, M. Å., Magoulas, T., & Pessi, K. (2008, June). Interoperability strategies for business agility. In International Workshop on Cooperation and Interoperability, Architecture and Ontology (pp. 108-121). Berlin, Heidelberg: Springer Berlin Heidelberg.

[27]. Ulrich, W., & Rosen, M. (2011). The business capability map: the" rosetta stone" of business/it alignment. Cutter Consortium, Enterprise Architecture, 24(4).

[28]. Ulrich, W., & Kuehn, W. (2015). Business Architecture: Setting the record straight. Business and Dynamic Change: The Arrival of Business Architecture. Herausgegeben von Frank Kowalkowski ua Lighthouse Pooint, Florida, USA: Future Strategies Inc.

[29]. Pinzón, C. (2016). TOWARDS A SUCCESSFUL ENTERPRISE ARCHITECTURE IN THE PUBLIC SECTOR.

[30]. Zachman, J. A. (1987). A framework for information systems architecture. IBM systems journal, 26(3), 276-292.

[31]. Hoogervorst, J. (2004). Enterprise architecture: Enabling integration, agility and change. International journal of cooperative information systems, 13(03), 213-233.

[32]. Franke, U., Hook, D., Konig, J., Lagerstrom, R., Narman, P., Ullberg, J., ... & Ekstedt, M. (2009, May). EAF2-A framework for categorizing enterprise architecture frameworks. In 2009 10th ACIS International Conference on Software Engineering, Artificial Intelligences, Networking and Parallel/Distributed Computing (pp. 327-332). IEEE.

[33]. Zachman, J.A.: The framework for enterprise architecture: background, description and utility(2016).https://www.zachman.com/resources/ea-articles-reference/327-the-framework-for-enterprise-architecture-background-description-and-utility-by-john-a-zachman", "Zachman, J.A.: Enterprise Architecture: Notes on The Zachman Framework (2012). www.zachman.com

[34]. Lin, F., Dyck, H.: The value of implementing enterprise architecture in organizations. J. Int.Technol. Inf. Manag. 19 (2010)

[35]. Kappelman, L.A., Zachman, J.A.: The enterprise and its architecture: ontology and challenges. J. Comput. Inf. Syst. 1–16 (2012)

[36]. Zachman, J.A.: The framework for enterprise architecture: background, description and utility(2016).https://www.zachman.com/resources/ea-articles-

reference/327-the-framework-for-enterprise-architecture-background-description-and-utility-by-john-a-zachman

[37]. S. Mrdalj and L. Urbaczewski. A comparison of Enterprise Architecture Frameworks. Issues in Information Systems, 7(2), 2006.

[38]. M. Lankhorst. Enterprise Architecture at Work: Modelling, Communication and Analysis. Berlin: Springer-Verlag, 2017.

[39]. The Open Group. Introduction Content Framework, 2013. https://pubs.opengroup.org/architecture/togaf91-doc/arch/chap33.html/,Accessed: 13-01-2021.

[40]. Dimitrov, V. (2012). An Overview of the Department of Defense Architecture Framework (DoDAF). Information Systems & Grid Technologies.

[41]. Rajamohan, P. (2014). An Overview of Virtual Router Redundancy Protocol Techniques and Implementation for Enterprise Networks. International Journal of Innovative Science, Engineering & Technology, 1(9), 554-562.

[42]. Mirsalari, S. R., & Ranjbarfard, M. (2020). A model for evaluation of enterprise architecture quality. Evaluation and Program Planning, 83, 101853.

[43]. Umiliacchi, S., Bhatia, D., Brownlee, A., & Brown, C. (2019). Enterprise architecture within railway systems engineering. IET Intelligent Transport Systems, 13(10), 1461-1467.

[44]. Anthony Jnr, B. (2021). Managing digital transformation of smart cities through enterprise architecture–a review and research agenda. Enterprise Information Systems, 15(3), 299-331.

[45]. Stender, M., & Walter, A. (2019). The role of social sustainability in building assessment. Building research & information, 47(5), 598-610.

[46]. Erl, T. (2008). SOA design patterns (paperback). Pearson Education.

[47]. Bernstein, P. A. (1996). Middleware: a model for distributed system services. Communications of the ACM, 39(2), 86-98.

[48]. Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate. Information systems, 54, 235-262

[49]. Smith, H., & Fingar, P. (2003). Business Process Management: The Third Wave. Meghan-Kiffer Press.

[50]. Weske, M. (2012). Business Process Management: Concepts, Languages, Architectures. Springer.

[51]. Davenport, T. (1993). Process Innovation: Reengineering Work through Information Technology. Harvard Business Press.

[52]. Kotter, J. (1996). Leading Change. Harvard Business Review Press.

[53]. Hosiaisluoma, E. (Date). ArchiMate Cookbook, Patterns & Examples. Publisher.

[54]. Hohpe, G., & Woolf, B. (2004). Enterprise integration patterns: Designing, building, and deploying messaging solutions. Addison-Wesley Professional.

[55]. Rozanski, N., & Woods, E. (2011). Software Systems Architecture: Working with Stakeholders Using Viewpoints and Perspectives. Addison-Wesley.

[56]. Lankhorst, M. (2013). Enterprise Architecture at Work: Modelling, Communication and Analysis. Springer.

[57]. Simon, D., Fischbach, K., & Schoder, D. (2013). An exploration of enterprise architecture research. Communications of the Association for Information Systems, 32(1), 1.

[58]. Lienert, C., Jenny, B., Schnabel, O., & Hurni, L. (2012). Current trends in vector-based Internet mapping: A technical review. Online maps with APIs and WebServices, 23-36.

[59]. P. Martin and B. Turner. Grounded theory and organizational research. The Journal of Applied Behavioral Science, page 22(2):141, 1986.

[60]. T. Moser and M. Williams. The Art of Coding and Thematic Exploration in Qualitative Research. International Management Review, 15(1):11, 2019.

[61]. J. Saldana. The coding manual for qualitative researchers. London: Sage Publications, 2009.

[62]. Larsson, H. (2011). Ambiguities in the early stages of public sector enterprise architecture implementation: outlining complexities of interoperability. In Electronic Government: 10th IFIP WG 8.5 International Conference, EGOV 2011, Delft, The Netherlands, August

[63]. Lankhorst, M. M. (2004). Enterprise architecture modelling—the issue of integration. Advanced Engineering Informatics, 18(4), 205-216.

[64]. Brosey, W. D., Neal, R. E., & Marks, D. F. (2001, October). Grand challenges of enterprise integration. In ETFA 2001. 8th International Conference on Emerging Technologies and Factory Automation. Proceedings (Cat. No. 01TH8597) (Vol. 2, pp. 221-227). IEEE.

[65]. Marini, G. (2019). Enterprise architecture and digital transformation (Doctoral dissertation).

[66]. Šaša, A., & Krisper, M. (2011). Enterprise architecture patterns for business process support analysis. Journal of Systems and Software, 84(9), 1480-1506.

[67]. Tang, L., Dong, J., Zhao, Y., & Zhang, L. J. (2010, July). Enterprise cloud service architecture. In 2010 IEEE 3rd International Conference on Cloud computing (pp. 27-34). IEEE.

[68]. Olavsrud, T. (2023). What is data architecture? A framework for managing data. CIO. https://www.cio.com/article/190941/what-is-data-architecture-a-framework-for-managing-data.html

Appendix A

Interview Protocol

This appendix outlines the interview protocol used in the research study to gather valuable insights from key stakeholders within the European Parliament. The purpose of these interviews was to gain a deeper understanding of the challenges and opportunities related to Enterprise Architecture integration in the public sector, with a specific focus on the Directorate-General for Translation (DG-TRAD) and the Directorate-General for Finance (DG-FINS). The interview protocol was carefully designed to elicit comprehensive responses that could contribute to addressing the research questions of the study. An overview of the interviews can be found in subsection ***3.2.2 Interviews***.

Introduction:

Introduce research project.
Assure confidentiality: "Your responses will be kept confidential and used solely for this research. If you ever feel uncomfortable answering a question or wish to end the interview, please let me know."

Purpose Clarification:

Explain the purpose of the interview and how the gathered information will be used.
Address the questions or concerns of the interviewee.

Section 1: Role and Experience
Can you provide a brief overview of your role and how it intersects with Enterprise Architecture in your organization?

Section 2: Benefits and Decision-Making

2. How has the implementation of Enterprise Architecture positively impacted your organization as a whole?

Could you share specific instances where Enterprise Architecture has notably enhanced decision-making within your organization?

Section 3: Alignment and Complexity Management

4. In what ways has Enterprise Architecture facilitated the alignment between your organization's IT strategies and its business objectives?

5. How has Enterprise Architecture assisted in managing the complexity of your organization's IT environment?

Section 4: Challenges and Relevance

6. From your experience, what are the primary challenges encountered when implementing Enterprise Architecture?

7. In your view, how relevant is Enterprise Architecture in the context of the public sector?

Section 5: Integration Process

8. Can you elaborate on the steps your organization undertook to successfully integrate Enterprise Architecture?

9. What were the most significant challenges faced during the integration, and how were these challenges addressed?

Section 6: Alignment with Strategic Goals

10. How did you ensure that the integrated Enterprise Architecture remained aligned with your organization's strategic goals throughout the process?

Section 7: Change Management and Sustainability

11. Handling resistance to change can be complex. Could you share how your organization managed resistance during the Enterprise Architecture integration?

12.After integration, how do you sustain the alignment of Enterprise Architecture with your organization's evolving needs and objectives?

Section 8: Daily Operations and Success Measurement

13. How has the integration of Enterprise Architecture impacted the daily operations within your organization?

14. How does your organization measure the success of the Enterprise Architecture integration?

Section 9: Advice for Others

15. Drawing from your experience, what advice would you offer to another organization considering the integration of Enterprise Architecture?

Closing:

Thank the interviewee for their time and insights.

Reiterate the confidentiality of their responses and express gratitude for their contribution.

Appendix B

Transcripts of Interviews

The whole set of interview transcripts is provided separately with this thesis.

Appendix C

Codebook

The full codebook is delivered separately with this thesis.

Appendix D

ArchiMate Diagrams

All ArchiMate diagrams are delivered separately with this thesis.

- *ArchiMate Director General - Translations Department Model*
- *ArchiMate Director General - Finance Department Model*
- *ArchiMate Diagram after Integration*
- *ArchiMate Design Patterns Application Diagram*