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ENTERPRISE ARCHITECTURE MANAGEMENT WITHIN THE GERMAN ONLINE ACCESS ACT

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ABSTRACT: This research addresses the application of the Enterprise Architecture Management (EAM) discipline to public administrative digitalization initiatives in Germany, proceeded within the Online Access Act (OZG) regulation, enacted as of 2017. Central object of this research is the concept of a 'Federal Integration- and Development Platform' (FIT-Connect), which is developed by Germany's Federal Agency for IT Cooperation (FITKO) on behalf of the Federal Government of Germany and the country's 16 State Governments. In collaboration with FITKO, this thesis applies Enterprise Architecture (EA) techniques in order to develop a comprehensive IT architecture of the FIT-Connect platform and its ecosystem. In order to do so, this research employs methods of Design Science (DS) and Information Systems (IS) research and develops, creates and evaluates architectural models as Information Technology (IT) artifacts. The proposed research outcomes are intended to serve as a basis for further development of the FIT-Connect platform project and as an example of EAM in the context of public administrative innovation in Germany. This research was carried out in collaboration with the FITKO Federal Agency for IT Cooperation. Terms retrieved from the practical research context are quoted [in German] and translated into English language. The presented architectural models may be made available upon request.

KEY-WORDS: Enterprise Architecture; Enterprise Architecture Management; Online Access Act; Platform Architecture; Platform Ecosystems; Public Administration Digitalization; Public Sector Innovation; Federal Republic of Germany.

I FIGURES

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II ABBREVIATIONS

Abb.	**English**	**[German if applicable]**
AöR	Public Agency	Anstalt des öffentlichen Rechts
API	Application Programming Interface	-
BMI	Federal Ministry of the Interior	Bundesministerium des Innern
BPMN	Business Process Modelling Notation	-
BSI	Federal Office for Information Security	Bundesamt für Sicherheit und Informationstechnik
DS	Design Science	-
DSRM	Design Science Research Method	-
EA	Enterprise Architecture	-
EAM	Enterprise Architecture Management	-
FAM	Federal Architecture Management	Föderales IT-Architekturmanagement
FIM	Federal Information Management	Föderales Informationsmanagement
FITKO	Public Agency for Federal IT Cooperation	Föderale IT-Kooperation
IS	Information Systems	-
ISO	International Organization for Standardization	-
IT	Information Technology	-
KoSIT	Coordination Office for IT Standards	Koordinierungsstelle für IT-Standards
LeiKa	Service Catalogue of the Public Administration	Leistungskatalog der öffentlichen Verwaltung
OZG	Online Access Act	Onlinezugangsgesetz
REST	Representational State Transfer	-

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1 Context and Preface

The Online Access Act (OZG) [Onlinezugangsgesetz] enacted by the Federal Government [Bundesregierung] of Germany obliges the federal, state and local governments in Germany to provide all administrative services online by the end of the year 2022. As part of the OZG Implementation Catalogue [OZG Umsetzungskatalog], the Federal Ministry of the Interior (BMI) [Bundesministerium des Innern], which is in charge of the project, has defined roughly 575 administrative services for citizens and businesses and has systematised them according to business and life situations [Geschäfts- und Lebenslagen], which are to be provided digitally within the suggested timeframe (Stocksmeier & Hunnius, 2018). Based on the OZG Implementation Catalogue, administrative specialists defined roughly 5.000 – 6.000 subordinated services underlying the 575 outlined OZG-services, which are to be digitalized within the OZG implementation process. In this context, the OZG confronts roughly 20.000 public administrations in Germany's federal, state and local governments with the challenge of structurally adapting their IT architectures within the required timeframe according to the regulation. This thesis recognizes the OZG implementation process as a complex and challenging project, which must be addressed from both an organizational and a technical perspective.

1.1 Introduction

This thesis was carried out in cooperation with the Federal Agency for IT Cooperation, (FITKO – AöR) [Föderale IT Kooperation – Anstalt des öffentlichen Rechts] as the executive authority of Germany's IT Planning Council [IT-Planungsrat], coordinating the administrative digitalization strategy in Germany and governed by the Federal Government of Germany and the nation's 16 State Governments [Landesregierungen]. The provided research contributions are based on documentations of FITKO-operations and were conducted in exchange with FITKO-personnel within a research internship for the duration of three months in the period from February till May 2020. The cooperation with FITKO substantially strengthened this research's ability to constructively address practice-oriented issues of the

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OZG implementation process, considering Germany's federated and decentralized public administration system. In addition to its practice-oriented conduction, this thesis builds its approach on established theory of Design Science (DS) research and Information Systems (IS) research, intended to create tangible IT (Information Technology) artifacts which can be utilized to support the OZG implementation process by developing an Enterprise Architecture for the FIT-Connect platform concept as one of the central digitalization projects of the FITKO agency. Furthermore, this thesis aims at complementing FITKO's governmental mandate to coordinate and implement administrative digitalization in Germany.

As FITKO in its operational function as the subordinated agency of the IT Planning Council coordinates the administrative digitalization of the Federal Government and the States, it conceptualized the project of a 'Federal Integration and Development Platform' (FIT-Connect) [Föderale Integrations- und Entwicklungsplattform], around which an ecosystem of administrative services is intended to be generated by public, corporate and even civil actors. While the FIT-Connect platform to date exists solely as a concept, this thesis aims at developing a first architectural model of the FIT-Connect platform in cooperation with FITKO.

Employing established DS methods and IS theory, Enterprise Architecture (EA) models will be created as IT artifacts, in order to increase the understanding of how the platform, its ecosystem and general integration scenarios can be structured. The relevance of the platform project and its value proposition with regard to the OZG implementation process will be addressed and respective implications will be incorporated within the design procedures carried out within this thesis. First, this thesis provides a theoretical overview of the EA discipline by elaborating on the concepts of Enterprise Architecture, Enterprise Architecture Management (EAM) and the ArchiMate modelling notation, as they provide a fundament for the further proceedings of this research. Second, central digitalization concepts of Germany's public administrative system will be described, to provide an impression of the context surrounding the FIT-Connect platform project. Central governmental digitalization initiatives will be explained, such as the Federal Information

Management (FIM) and Federal Architecture Management (FAM) strategies, the OZG regulation and eventually the FIT-Connect platform project.

Subsequently, the research proposal of this thesis will be put forward by defining the research subjects and motivating their relevance, as well as by providing a practice-oriented motivation of how the research may contribute additional value to the OZG implementation process in Germany. The research proposal will summarize and motivate the intentional research contribution of this thesis, which is grounded on the understanding of EAM as a means of managing complex technical and organizational transformations and aims at developing an initial IT architecture of the FIT-Connect platform. Through its elaborations, the research proposal serves as an illustration of the research endeavour of contributing to an effective and efficient implementation of the OZG regulation and to the goal of supporting the digitalization of public administrations on all federal administrative levels of the German government. This section is followed by the elaborations on the methodological framework of this research, as this thesis bases its empirical contributions on theory of the Design Science research stream and applies the Design Science Research Methodology (DSRM) as a result-oriented method to develop solutions for tangible issues in the area of study.

Following the methodological steps of the introduced theory, the empirical development process of EA models will be executed through the design of the FIT-Connect platform architecture and ecosystem, the platform's interface architecture, as well as selected stakeholder views to illustrate the essential structure and functioning of the provided design. In addition to representations of the platform's business- and application structure and behaviour, also motivational concepts of the ArchiMate notation will be employed to illustrate various implementation scenarios supported by the FIT-Connect platform. This empirical presentation will be concluded by a structured evaluation step, within which the designed models will be demonstrated to specialists of the FITKO agency in order to achieve an objective assessment of the research contribution's quality and its applicability with regard to the defined problem- and objective definitions. Subsequently, the proposed EA

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models will be iteratively adapted in accordance with the assessment within the evaluation. Lastly, this thesis closes with a critical reflection on the conduction of this thesis and its limitations, followed by a conclusion and outlook regarding the overall context and topic of the research.

2 Enterprise Architecture Theory

This section is intended to contribute to an increased understanding of Enterprise Architecture and Enterprise Architecture Management at the intersection of organizations and technology, specifically the IS research stream. The following is an attempt to describe how the terms can be defined and how they are relevant for the transformation of organizations. Also, this section aims at motivating the usefulness and suitability of EA measures in the context of Germany's public administrative digitalization processes.

2.1 EA

The term 'architecture' and its origin from the building- and construction context was lent by the IT industry, when its actors started to find themselves confronted with complex structures and decisions (Lankhorst, 2017).

In their publication on the 'IT-Architecture of the IBM System/360', Amdahl et al. (1964) provided an early definition of the term 'architecture' in the context of computer science: "The term architecture is used here to describe the attributes of a system as seen by the programmer, i.e., the conceptual structure and functional behavior, as distinct from the organization and data flow and control, the logical design and the physical implementation" (Amdahl et al., 1964). 'The Open Group' as one of the leading industry consortiums in the development of standards, services and systems in the sphere of Information Technology, defined an 'Enterprise' as "Any collection of organizations that has a common set of goals (e.g. government agencies, whole corporations, divisions of corporations, single departments, chains of geographically distant organizations linked together by common ownership)" (The Open Group, 2018).

The 'International Organization for Standardization' (ISO) defined 'architecture' as "The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution" (ISO/IEC, 2000). The term 'Enterprise Architecture Management' is based on the understanding, that solely EA as such is not sufficient for the purpose of enterprise transformation. The addition of the term 'Management' to the term 'Enterprise Architecture' results in EAM, which describes the application of a methodology to EA, in order to transform organizations from one state to another. Consequently, EA and EAM are complementary to each other and reveal their significant value only together (Winter & Fischer, 2007).

2.2 EAM

Specifically, EAM can be defined as the "use of models, frameworks, principles, and viewpoints by architects and other stakeholders in order to strategically govern business and technology in an integrated, IT supported manner with the aim of describing the current and desired state of the enterprise and transforming it as a response to internal and external challenges" (Lankhorst, 2017). Other researchers who published in an Enterprise Architecture context described EA as a means to "support organizations in managing the complexity of their business environment and facilitate the integration of strategy, personnel, business and IT" (Lemmetti & Pekkola, 2012), or as a tool to provide a holistic view of an organization to enhance collaboration between "aspects of business planning such as goals, visions, strategies, and governance principles; aspects of business operations such as business terms, organization structures, processes and data; aspects of automation such as information systems and databases; and the enabling technological infrastructure of the business such as computers, operating systems, and networks" (Dwivedi & Irani, 2009).

When defining EA and EAM, it is important to generally note that there is a lack of stringent definitions and understandings among researchers and therefore a coherent theoretical basis in the sphere of EA research is not given. Despite this matter, a consciously shaped IT

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architecture in response to changing conditions provides an enterprise and its stakeholders with essential instruments to manage complexity, which enables informed decision-making, planning and governing of transformations (Schönherr, 2008). Just like other systems, the information system architecture in Germany's public administration must transform itself over time as requirements change. Important previous requirements may become obsolete in the future due to changing environmental factors. Therefore, the successful implementation of the OZG legislation requires a comprehensive IT architecture to digitalize public application- and reporting procedures on a large scale across the country's regions and its hierarchical layers. Key success factors are stable frameworks, such as standards and interfaces to enable cross-sectional communication among differing technical infrastructures and organizational procedures in Germany's federated administrative system.

In this sense, EA can serve as a conceptual draft that defines the structures and operations of organizations. The intention of EAM then is to aggregate how organizations can achieve their current and future objectives. In order to do so, EAM aligns organizational aspects of business, information, data, application and technology to support strategic outcomes. In case of the German administrative digitalization process, the requirements of all actors and stakeholders must be adequately identified and addressed, the federal EA must be realized within a defined time frame and in a resource-efficient manner. Ultimately, a balance between decentralized autonomy of federated decision-making and centrally enforceable standards must be found. For structuring this complex development process, EAM implementation can be an appropriate initiative to align organizational and technical dimensions. These dimensions comprise high degrees of complexity and highly differentiated strategic goals, tasks and processes within organizations, extensive dependencies between organization-specific goals, tasks and processes, diverse connections and dependencies to the outside world (e.g. society, customers, partners, service providers). For these various dimensions of innovating of Germany's complex federal administrative architecture, EAM offers suitable solution approaches.

To summarize, EAM is a methodology for planning and bridging gaps and aligning business, information and technology aspects of whole organizations from a strategic perspective. EAM unfolds its effects through the application of definitions, standards, defined relationships and design principles utilized as tools for change. Executed poorly, it causes an incomprehensible and unaccountable bottleneck effect between business and technology that hurts an organization. Executed effectively, it provides a strategic, clear, commonly understood and commonly applied approach to technology and system design. In combination, the elements of EAM result in a comprehensive systemic description of an enterprise and in this way shapes organizational reality (Kearney, 2020).

2.3 ArchiMate

Within this thesis, the ArchiMate modelling language will be applied as an open and independent notation to support the description, analysis and visualization of the German federal administrative IT architecture, specifically within the FIT-Connect project across the different organizational domains. ArchiMate represents a clear set of EA elements and concepts, providing a simple and unified structure of relationships and descriptions of their contents across different domains. An extensive and detailed description of ArchiMate as an open specification was developed by the OpenGroup (2019) and is privately employed by various tool suppliers and consulting firms.

In order to represent the federal architecture of German administration in an EA modelling notation, this thesis applies the open source software Archi (2010), which offers a modelling tool and has been utilized broadly since its introduction. As of 2010, Archi has been widely applied and adopted for real-world use. The exercised modelling within this thesis includes ArchiMate’s three elementary key layers, namely the Business Layer (Yellow), Application Layer (Blue) and the Technology Layer (Green). Additionally, the applied elements comprise Active Structure Elements, Behavior Elements and Passive Structure Elements. This variety of elements will be employed across different architectural layers and connected with each

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other through 'Relations', representing relationships between elements. Following, Figure 1 displays ArchiMate's key elements on the application layer.

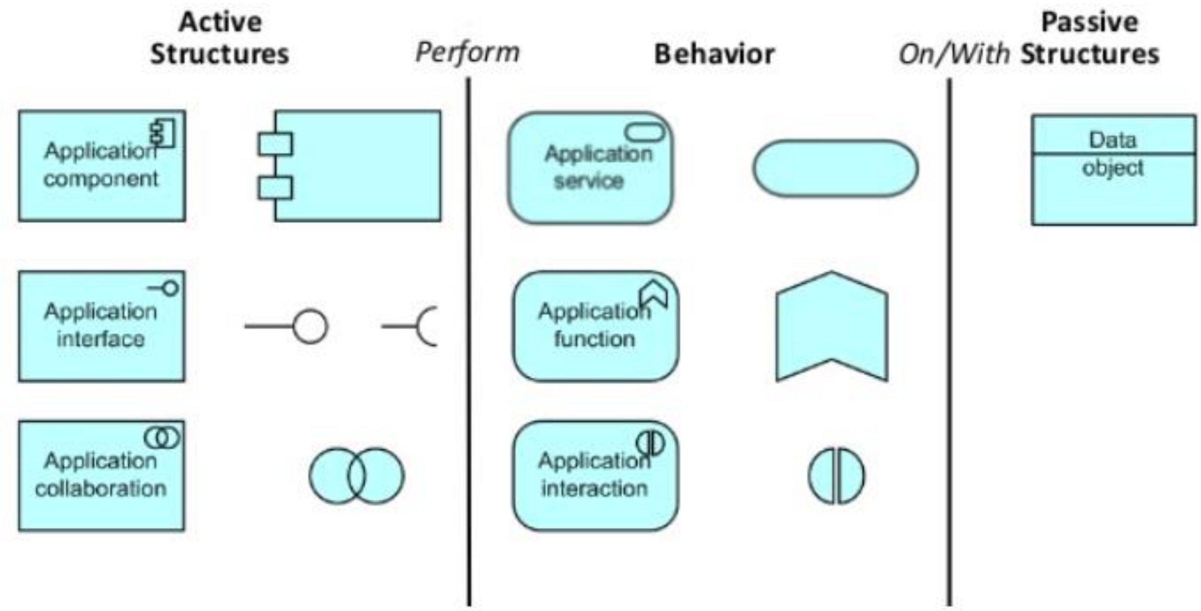

Figure 1: Key Elements of the ArchiMate Notation Application Layer (Archi, 2010a)

Among the configurational regards of this thesis, ArchiMate's motivational extension is added to the architectural models. The motivational concepts allow to describe reasons and constraints that underlie the design and development of EA. Motivation elements such as goals, principles, requirements and constraints are caused by stakeholders, drivers and assessments. Following, Figure 2 represents ArchiMate's motivation concepts.

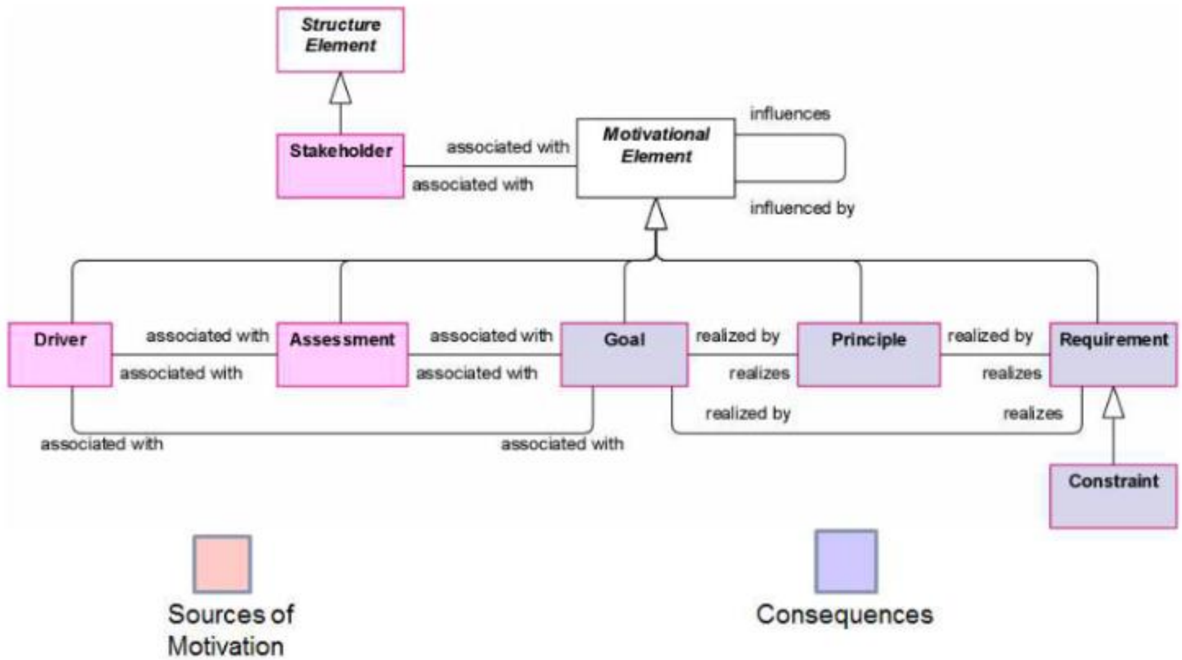

Figure 2: ArchiMate Motivation Extension Meta Model (Archi, 2010b).

The described modelling concepts will be employed within this thesis to represent and to develop EA initiatives within the coordinated digitalization processes of Germany's public administrations. As elaborated in the further course of this research, the ArchiMate notation will be utilized to design central elements of the federal IT architecture development initiative. Also, applying the ArchiMate motivation extension, configurational views of interaction scenarios across different technical and organizational domains will be taken. A more detailed elaboration on the utilized ArchiMate elements, relations and layers and their application to the research subject of this thesis will be provided in the modelling section using specific and exemplary models.

3 Administrative Digitalization Concepts

In the course of OZG implementation, the decentralized, federally organized administrative structure of Germany provides potentials for the exchange of knowledge, services and competition, although the approaches pursued by different administrations are very heterogeneous. Established structures for federal coordination and cooperation exist in the form of the IT Planning Council and the FITKO. However, nationally coordinated requirements for the further development of standards are still largely lacking. In the medium term, the challenge will be to develop cross-regional and state-wide IT architectures into a convergent overall picture for the whole country. This section is intended to provide a brief overview of current administrative digitalization concepts undertaken in Germany.

The leading actors of the OZG process are the Federal Government and its subordinate authorities, such as the Federal Ministry of the Interior, the Federal Agency for Security and Information Technology (BSI) [Bundesamt für Sicherheit und Informationstechnik] and the Digital Cabinet [Digitalkabinett]. Reflecting the federated structure of Germany's public administration, the IT Planning Council and the FITKO coordinate the national e-government strategy between the Federal Government and the 16 States [Bundesländer] of the German Republic (IT-Planungsrat, 2019). The IT State Treaty [IT-Staatsvertrag] which came into force in April 2010, serves as the legal basis for the IT Planning Council, defines the objectives of the cooperation between the Federal Government and the States and established the IT Planning Council as the central organisation for federal cooperation in information technology (IT-Planungsrat, 2019a).

The FITKO constitutes the operational foundation of the IT Planning Council, which coordinates and promotes the administrative digitalization and develops respective solutions in coordination with all federal levels of the German government. FITKO's tasks are to develop and implement the federal IT strategy and architecture and to transparently develop IT solutions in cooperation with all relevant stakeholders. Specifically, the FITKO coordinates the OZG implementation, the Federal Information Management (FIM) and develops the Federal IT Architecture. In order to enable FITKO to realize its tasks, the Federal Government and the States agreed to provide it a digitalization budget of up to 180 million euros for the years 2020 to 2022 (BMI, 2020).

In 2007, the Federal Government agreed on guidelines for IT governance in order to define common standards and architectures for its administration. In 2009, the principle meta model 'Federal IT Control Architecture Framework' [Rahmenarchitektur IT-Steuerung Bund] was released, which defined the basic principles, approaches and terminology on the basis of which EAM in the Federal Government should be designed. Based on the meta model, architectural principles were formulated and architecture-relevant goals were defined in order to prevent heterogeneous and contradicting developments in different administrative units (BMI, 2019). It should be noted that the architectural principles and guidelines address solely the federal (national) level of Germany's administration and federal cooperation is not considered. Furthermore, the formulated guidelines and principles are neither binding, nor is their compliance being controlled. In terms of federal cooperation, the IT Planning Council and operationally the FITKO are responsible for the conception of a federal, cross-regional and state-wide IT architecture management (FAM).

As part of the IT Planning Council, the Coordination Centre for IT Standards (KoSIT) [Koordinerungsstelle für IT-Standards] is authorized by the IT State Treaty to develop and implement binding interoperability- and security standards. As part of a standardization roadmap [Standardisierungsagenda], the KoSIT identifies standardization demands in the federal context and the IT Planning Council then defines obligatory IT standards for the federal- and state agencies (KoSIT, 2015). For instance, a large number of administrative procedures [Fachverfahren] are applied in public administration, between which data and information are exchanged and transmitted electronically. The XöV standard for federal data exchange introduced by KoSIT enables public administrations to demand and to verify assured functionality, service quality, data protection and data security for cross-regional end-to-end communication. The standard defines uniform and mandatory requirements for the transport of information with their interfaces to administrative procedures to the transport infrastructure (KoSIT, 2015).

But despite the continuous work of the IT Planning Council, FITKO, KoSIT and other institutions, the development of a uniform IT architecture in Germany still reveals significant deficits. Regarding the OZG implementation process major shortcomings are standardized interfaces, uniform basic components and harmonized framework architectures. Moreover, the development of interoperability standards such as the XöV typically is a time-consuming

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methodical process, which requires a large amount of resources. The public administration faces various obstacles in its EA development by a lack of qualified staff, usage of heterogeneous operating- and legacy systems, and differing procedures on different federal administrative levels. In summary, the complex and heterogeneous nature of Germany's federated public administration system complicates comprehensive transfer of IT standards as a basis for comprehensive EA development.

3.1 OZG

The Online Access Act (OZG) [Onlinezugangsgesetz, full title: Gesetz zur Verbesserung des Onlinezugangs zu Verwaltungsleistungen] is a federal law from 2017 on the nationwide digitalization of the German administration by the end of 2022. The law is intended to improve interactions of citizens and companies with the administration by making them faster, more efficient and more user-friendly. Therefore federal, state and local authorities are to provide their administrative services online via administrative portals (BMI, 2020a).

The OZG implementation catalogue identifies roughly 600 administrative services which are then grouped by 35 life- and 17 business-situations [Lebens- und Geschäftslagen] and assigned to 14 subordinated topic-areas [Themenfelder] (i.e. "Family & Child" and "Business Management & Development"). By applying its categorization of services, the OZG implementation catalogue is intended to be based on the user perspective of citizens and enterprises and not on the administrative responsibilities (BMI, 2020a). Several actors involved in the OZG implementation criticized the number of 600 services as "politically motivated", because an estimated number of 5.000 – 6.000 more concrete services would be subliminally concealed under the services as bundled in the OZG implementation catalogue. This objection is based on the number administrative services defined in the service catalogue of the public administration (LeiKa) [Leistungskatalog der öffentlichen Verwaltung], which constitutes a uniform, complete and comprehensive inventory of administrative services across all federal levels in Germany and forms the basis for both the

OZG and the Federal Information Management (FIM) as their predecessor (IT-Planungsrat, 2020a).

The OZG is being implemented through two digitalization programs. Within the Federal Digitalization Program [Digitalisierungsprogramm Bund], all services with regulatory and enforcement competence at the federal level are digitalized under the responsibility of the federal government across all topic-areas. The federal government is solely responsible for the legislation and execution of its federal services and therefore does not need to coordinate with the states and municipalities. Thus, the services of entire political resorts can be identified, structured and directly implemented in OZG projects by the respective federal authorities (BMI, 2020b).

In Germany's federal administrative system, states and municipalities each possess very different variants of services, application forms, software and more complex responsibilities. Therefore, the services with regulatory and/or implementation competence at the States' or municipal levels are digitalized within the Federal Digitalization Program [Digitalisierungsprogramm Föderal] (BMI, 2020a). Within the Federal Digitalization Program, the federal government and the states established a work-sharing approach, considering federal- and state responsibilities for each of the 17 topic-areas. By collaborative participation of representatives from all administrative levels and inclusion of user expertise, they elaborate a digitalization concept and coordinate its implementation: In digitalization laboratories [Digitalisierungslabore], experts from the from law-, IT- and organizational backgrounds develop suitable solutions for all federal actors (IT-Planungsrat, 2020).

Following the principles of work-sharing and re-use, the developed deliverables are made available to the other states for subsequent utilization [Nachnutzung] in order to achieve nationwide availability and resource-efficiency (BMI, 2020a). The municipalities are to be involved by the states. In addition, the communal top associations are members of the IT planning council and are therefore represented in the projects. They accompany the implementation of the OZG and incorporate communal interests of the municipalities. The aim is to create user-friendly digital services that can be easily re-used by other states and municipalities (IT-Planungsrat, 2020).

According to the OZG manual [OZG-Leitfaden] published by the BMI (2020c) in collaboration with FITKO, user centricity should always be at the focus when designing digital services. Regular user feedback and respective iterative further development are thus essential, particularly in the conception of prioritized services in digitalization laboratories. The objective of any new concept should be to develop an attractive online solution that can reach and appeal to the largest possible number of users and that is also significantly easier and simpler for users and implementation (BMI, 2020c). In addition, according to the OZG manual, when designing digital services, care must be taken to ensure that the artifacts developed can be widely re-used by involving many states, municipalities and other important stakeholders in the design process as early as possible. Moreover, it is important to integrate already existing, user-friendly elements (BMI, 2020c).

The deliverables produced in the digitalization laboratories then provide the basis for the implementation of OZG services. They typically include a visual representation of the developed to-be process and a process model based on the Business Process Modelling Notation (BPMN). The visual representation serves as an illustration to technical implementers and political decision makers, while the process model provides a technical semantic representation of the developed to-be processes for the most frequently occurring administrative procedures. Both deliverables then are submitted to a respective IT service provider for development (BMI, 2020c).

Depending on external circumstances, the start of the project implementation may be delayed, e.g. by the lack of available of project staff, slow coordination processes within administrative agreements, or public procurement restrictions when selecting an IT service provider (BMI, 2020c). Moreover, the OZG implementation process being part of a change management dimension, may suffer from partial lack of acceptance of developed solutions among public servants. From a technical and organizational point of view, the interfaces and transfer points are defined and standards for data exchange developed (BMI, 2020c).

The development and implementation of OZG services is based on artifacts defined within the Federal Information Management (FIM) representing the as-is state of administrative procedures in Germany, which will be further explained in the following section. Furthermore, the OZG legislation additionally requires a Portal Network [Portalverbund] connecting administrative portals cross-regionally online, which is fundamental to the OZG implementation process and administrative service provision, but yet not a primary subject of this thesis. Primary challenges of the OZG implementation process are a lack of consistent technical interfaces for transactions and for the binding of reusable basic components or registries, but also lack of a standardized approach to integrate components in a scalable way.

3.2 FIM

The Federal Information Management (FIM) is a control project of the IT Planning Council which is coordinated by the FITKO. Its goal is to harmonize information on administrative processes between the federal government, the states, and local authorities. Currently, administrative units in Germany have different application forms triggering different administrative processes. Responsibilities are divided in Germany’s federal-administrative system with the result that the states implement national law as a sovereign matter. Nevertheless, there is no systematic transition between federal legislation and law execution in the states. In practice, there are various individual execution paths, where individual processes and terms are defined, differing in their terminology and technical design.

Therefore, federal law is implemented in different ways in different parts of Germany. This has negative consequences, including an increased risk of formal and substantive errors, longer periods between enactment and execution of law, increased implementation costs and less processing time for administrations. FIM is intended to standardize, harmonize and optimize the processes, application forms and service descriptions of administrative units.

FIM consists of three modules that act as building blocks in the system. the first one is the 'services' [Leistungen] module, which contains descriptions of administrative services. Thus,

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citizens and companies are informed about the services offered by public administration. The 'services' module contains a scheme for uniform descriptions of administrative services in order to provide subordinate authorities with quality-assured service descriptions [Stammtexte] that can be reused for future purposes. The service descriptions are based on the corresponding legal texts and are translated in a standardized manner from legal language into a target group-appropriate implementation language [Vollzugssprache], which should be intuitively comprehensible for users, such as citizens and companies.

The second module 'data fields' [Datenfelder] represents the application form elements required by users to request a certain service and to submit the necessary data. Particular services are linked to corresponding forms. Within the framework of the 'data fields' module, data structures for service applications are to be modelled uniformly and made available centrally via the FIM portal for the inclusion of other authorities providing similar services. The third and final module is the 'process module' [Prozesse]. Processes lead to the delivery of a service and are usually triggered by the submission of a form. The process module also contains uniform regulations for process modelling and centrally provides quality-assured, reusable sample models for other administrative units in a corresponding repository.

In order to achieve a standardized infrastructure, there are four methodical steps be followed within the building blocks of FIM. The first step is the classification. Classified services, forms and processes are clearly defined by a unique national identification number. Classified objects can be named at choice by different administrative bodies, as long as they have a unique identification number. This enables a comparison of differently named - but equally targeted - services. The identification number is derived from the service catalogue of the public administration (LeiKa).

The second stage addresses the structuring of the contents within the building blocks. This includes the standardization of data fields for application forms, which must be defined and related to other data fields. These data fields represent the requirement for respective information, which is defined by legislation and trigger a certain process. For the modelling of a process, templates are to be provided via the FIM Portal. Such a harmonized structure

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simplifies the implementation of software solutions, since compatibility between data fields and processes facilitates comparison of deliverables within public administration.

After the building blocks have been classified and structured, they should be qualitatively and editorially standardized. The standardization is primarily directed towards the application forms. The federal government drafts an editorial template that complies with the requirements of the federal legislation. It is then adapted by the states according to their country-specific criteria and from there forwarded to the municipalities. These then again supplement the templates with information corresponding to their communal procedures and services. This process results in time savings through non-recurring work and more consistent application forms. At the same time, it is important to maintain the reusable templates at a relatively low degree of detail, in order for them to be applicable for differing use cases.

The final step after classification, structuring and editorial standardization is the technical standardization of file formats to make application forms and process models interchangeable, applicable and optimizable without any media discontinuities. These four methodical steps aim at a standardization of the federal information management. The result of this process is intended to be classified and structured, along with editorially and technically standardized objects, which allow for a transparent and more efficient process infrastructure with its associated elements.

This creates the conditions for reuse [Nachnutzung] in the states and municipalities. The FIM service descriptions which are formulated by the federal editorial office and based on federal law, provide a legal basis and can be adapted to the laws of the states if required. FIM also allows to supplement objects with municipal-specific implementation information and to generate automated online applications. The greatest potential for reuse exists in the case of federal services, i.e. services based on federal law, as these have the lowest degree of disparity.

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At present, the FIM reflects the 'As-Is' state of affairs of the administrative services originating from the LeiKa service catalogue. The objects developed within the FIM-framework are to be transferred into corresponding repositories collecting reference templates and models, in order to derive requirements and to successively transform the as-is state of administrative IT-infrastructure towards a desired to-be state.

3.3 FAM

As discussed earlier, Germany's administrative landscape consists of largely heterogeneous organizational structures, processes and IT systems. Nevertheless, through the IT Planning Council and the FITKO, there exist legal foundations with established structures and concepts (OZG, FIM, FAM, FIT-Connect) enabling a coordinated transformation from the current federal administrative structure and its separated approaches towards a more coherent and integrated federal IT architecture.

Accordingly, as part of Germany's federal digitalization strategy, FITKO got assigned by the IT Planning Council to develop a comprehensive federal IT architecture and to conduct Federal Architecture Management (FAM) [Föderales IT-Architekturmanagement]. The objective is to achieve a possibly ideal interaction between the IT structures of all federal administrative levels. Particularly, the federal IT architecture is intended to contribute to a timely and efficient implementation of the OZG. In accordance with the IEEE 2000 Software Engineering Standard, FITKO defined IT architecture as the fundamental organization of a system, embodied in its components (parts), their relationships to each other and their environment, and the principles which guide its design and evolution.

FITKO's terminology of 'architecture' comprises both the organizational architecture (business structures, processes and actors), as well as the technical architecture (applications, data, hardware and other IT infrastructures). Accordingly, the focus of the Federal Architecture Management project lies on the planning and control of organizational and technical structures within Germany's federated administrations and their respective agencies.

Through the Federal Architecture Management (FAM), FITKO and the IT Planning Council aim to efficiently achieve the best possible interaction between the IT structures of all administrative levels and to support the current and future goals of Germany's administration. As one of the central functions of EA is the reduction of systemic complexity, the Federal Architecture Management approach is to provide a comprehensible presentation of the current and future federal administrative architecture as a basis for technical and organizational decision-making. Following the complexity reduction, Federal Architecture Management then can support complexity management and align architectural changes with current and future strategic requirements through analysis- and controlling measures.

FITKO identified several functions and tasks of a Federal Architecture Management, including the strategic planning, coordination, controlling and execution of standards and architectural projects. More specifically, the operational domains of FAM comprise the public administrations' business architecture (services, processes, responsibilities), information systems architecture (applications, data, intersections) and technology architecture (hardware, middleware, information systems infrastructures). Within these architectural layers and across all federal administrative levels, FAM is to coordinate the development and enforcement of federal architectural standards and basic components, as well as the support and coordination of all federal actors in their cooperative planning of IT applications.

In this context, the concept of the Federal Integration and Development Platform 'FIT-Connect' should also be examined. Its purpose is to provide a transparent framework for those responsible for implementing the OZG and for IT service providers to develop solutions for administrative services that can be used rapidly and economically throughout Germany. FIT-Connect is essentially built on the goal to form a framework architecture for Germany's distributed federal IT structure and is intended to enable the scaling and subsequent use of developed online services (eGovernment Computing, 2020).

3.4 FIT-Connect

Discussions on solutions for OZG implementation, but also discussions of administrative digitalization in general, often concern the following issues: Should citizen- or customer service be offered centrally or locally? Should a service be provided or developed by the government itself or by the private sector? Building on O'Reilly's (2010) idea to regard the 'Government as a Platform', FITKO pursues the development of a Federal Integration- and Development Platform 'FIT-Connect' [Föderale Integrations- und Entwicklungsplattform]. According to the FIT-Connect concept, the government publicly provides a digital basis of functions and data based on open standards and components, in the sense of a platform. In this respect, FIT-Connect intends to enable all societal stakeholders (public authorities, companies, non-profit organizations, citizens) to create and consume new digital solutions. At the time of this thesis, the FIT-Connect project has entered the proof of concept phase, which is supposed to principally prove the viability of the project. As discussed in the following section, this research is concerned with the development of a prototype for the FIT-Connect platform that provides the required core functionalities, which are going to be outlined next.

On FIT-Connect, administrative services may be integrated, contracted and purchased by the government or be implemented by actors as commercial- and social models. Around FIT-Connect as an open platform, a powerful ecosystem could evolve combining external solutions with its own solution-specific services and components. In this way, new solutions for different target groups could be created potentially faster, more innovative and more cost-effectively than a single organization or government could execute such a transition. A central challenge in the development of FIT-Connect will be to make it attractive to stakeholders. As the attractiveness of the platform increases, along with it does the size and performance of the surrounding ecosystem, including benefits for the platform initiators. The main drivers to the attractiveness of FIT-Connect will be a simple access for users, opportunities for the self-development of solutions or business models and a high degree of market access through many stakeholders using the platform. The previously posed questions regarding private or public provision of administrative services, as well as addressing centrally or locally provision of services can be resolved by means of the FIT-Connect platform. Based on an open platform and a performing ecosystem, digital services can be provided centrally, locally, publicly and privately. Also, hybrid forms of different stakeholders collaborating in their service development and -provision are conceivable.

In the following, essential aspects of FIT-Connect development will be discussed in further detail, in order to provide a basis for further design steps. First, the development process builds on uniformly defined and federally applicable interfaces and integration architectures. This enables application services and processing systems to integrate administrative basic components for electronic transmission and processing of applications on a consistent basis for their development. Second, FIT-Connect is to provide cross-organizational integration components to minimize development efforts and to reduce redundant costs from recurring integration procedures. Basic building blocks of FIT-Connect are repositories containing openly accessible resources, information and guidelines for the development of digital administrative solutions, as well as open application programming interfaces (API's) based on public and accessible standards. Through API's, stakeholders and their solution-specific services (public, private, commercial, non-commercial development) can communicate with governmental services (developed by specific or cross-sectional administrative departments) and have the ability to access open data or publicly provided registry data.

Moreover, fundamental requirements for the FIT-Connect platform are freedom of implementation in the sense that the platform provides additional value for all actors and all conceivable implementation models, without questioning existing OZG-implementation concepts. Also, FIT-Connect will is designed as a uniform platform, which nevertheless allows various solution approaches. The platform strategy itself does not require a nationwide centralization of basic administrative services, but yet standardizes and simplifies the integration of different administrative services with developed solutions. Another requirement of FIT-Connect development is its expandability and adaptability, in the sense

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that federal, state, local and solution developers should be able to expand the platform core by further services and solution-specific functions.

FIT-Connect aims to reduce development and integration efforts by providing a nationwide uniform integration architecture for all common use cases with lightweight and market-standard interface technologies. The platform centrally provides integration components, as well as tools and resources, in order to reduce duplicated efforts in application development. This applies in particular to cross-sectional responsibilities of Germany's administration, which are often performed in parallel by different departments in various states and regions. FIT-Connect is to provide standardized integration patterns and interfaces, in order to enable reusability and scalability of solutions. Also, the platform reduces complexity for responsible actors through its generally applicable conditions. In principle, all components of the platform should be openly available, in order to create an efficient solution market for the administration and external. In this way, a variety of compatible solutions can be created, which enables prompt adaptation to new requirements and technological trends.

In this sense, the Federal Integration- and Development Platform represents a strategic approach to address the current challenges in the decentralized OZG implementation process. The FIT-Connect platform is intended to provide actors responsible for OZG implementation and solution developers with a stable and comprehensive basis for developing economically usable and interoperable solutions for administrative services throughout Germany. In order to achieve its desired effect, the FIT-Connect platform provides light interfaces based on established industry standards along with centrally provided integration components to solve and minimize recurring integration challenges in decentralized federal administrative procedures. By doing so, it provides a shared development platform with centrally available development- and test tools to simplify and accelerate the development of interoperable procedures for application submission and application processing.

The FIT-Connect platform follows an open platform concept and is intended to initiate a cultural change in the development of digital public management solutions. In this way, government institutions provide a digital basis of functions and data based on open standards and components freely available to everyone. This enables all societal actors to independently create new digital solutions and innovations. Developed solutions may be integrated, ordered or purchased by the administration or they can be integrated outside the state within new commercial or social business models. The platform is purposely not conceptualized as a central approach, but rather as a federally organized approach, since a high degree of autonomy is maintained in the development of application services and application processing systems to be implemented by respective stakeholders.

If implemented successfully, the FIT-Connect platform will initiate the development of a rich heterogeneous ecosystem around it, comprising various stakeholders contributing to the overall selection of public services and thus to an effective OZG implementation by reducing the centrally allocated development efforts for public administrative organizations. The following sections elaborating on the particular research design of this thesis will further specify the platform approach and the functioning of platform ecosystems. Further examination will also be provided regarding the concrete application of the platform approach to the OZG implementation and Germany's decentralized public administrative system in general.

4 Research Proposal

This section illustrates the research proposal in more detail by elaborating on the research subjects and selected empirical methods, as well as by providing a practice-oriented motivation of how the research may contribute additional value to the OZG implementation process. Regarding EAM as a means of aligning technical and organizational challenges, this thesis proceeds by developing an initial Enterprise Architecture based on the FIT-Connect concept of FITKO. The architectural model of the platform will comprise its core elements on different architectural layers (business, application, technology) and is intended to demonstrate how the platform is structured and how it links the federal- and state

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architectures within Germany's administration system, as well as how it interacts with external actors.

Based on the developed FIT-Connect architecture, a configurative design process follows, in which different instances of application- and implementation scenarios within the FIT-Connect ecosystem will be analyzed and presented as universally applicable and individually adaptable reference models. The configurative modelling procedure will be based on prior analysis of existing documentations of the FIT-Connect concept and on theory addressing platform ecosystems, applied to the German administrative context. Within the configurative modelling process, the 'Motivation Extension' of the ArchiMate EA modelling notation will be added to the business-, application- and technology layers of the architectural models. The Motivation Extension of the ArchiMate language allows to represent stakeholders, drivers for change, business goals, principles and requirements to the architectural models, which will be of significant relevance within the configurative modelling approach of this thesis.

The configurative proceedings are intended to answer the following questions: How do administrative units receive applications, by what means are applications submitted and accessed, which technical aids are used, are additional steps carried out, are intermediaries involved, can processes be (wholly or partially) outsourced, how are data transmitted? These procedural details are to be analyzed on the basis of selected application- and implementation scenarios and will be architecturally represented in universally applicable reference models. Subsequently, it will be possible to integrate the configurative reference models into the main architecture of the FIT-Connect platform, resulting in a FIT-Connect platform ecosystem.

Noting a lack of structural and technical standardization within Germany's public administrations and their respective information systems as one of the main obstacles to overcome towards a successful, efficient and timely implementation of the OZG regulation, this thesis intends to motivate the application of Enterprise Architecture Management as an essential set of tools and methods to manage the organizational and technical complexity of Germany's administrative digitalization process. In that manner, this thesis contributes to the

FIT-Connect platform project, which FITKO has developed as part of its federal IT architecture strategy, by designing an initial Enterprise Architecture model based on the FIT-Connect concept. As illustrated above within the description of FIT-Connect, the design of the platform's IT architecture will effectively support the goal to reduce development and integration efforts by providing a nationwide uniform integration architecture.

The subsequent configurative design of reference architectures for administrative procedures, such as application submission, application processing and other dimensions of the platform ecosystem, is intended to act as a complementary addition to the FIT-Connect architecture. These measures are based on the assumption, that the development of universally applicable and individually adaptable reference models can contribute to a cooperative approach within the OZG execution process. More specifically, developing the FIT-Connect EA and abstracted reference architectures are expected to enhance interoperability and to harmonize the interaction between different administrative entities, their IT systems and external stakeholders such as citizens, corporations, or service providers. Another strong argument for reference implementation is the demand for reusability of services and architectural constructs, which allows existing solutions to be integrated with little configuration effort into various contexts. In this respect, customizable reference architectures may be able to significantly contribute to the cost-efficiency of the OZG implementation.

Regarding empirical methods selected for this thesis, Design Science (DS) research was considered as the most suitable methodological approach for architectural design (Hevner et al., 2004). The 'Design Science Research Methodology for Information Systems Research' (DSRM) will be introduced in the following section, as the DSRM approach will be applied to the EA development process for the FIT-Connect platform (Peffers et al., 2007). Each of the mentioned empirical concepts and their practicability for the design and evaluation of sociotechnical artifacts will be described in the following section.

To conclude, this thesis grounds its research on the understanding of EAM as a means of managing complex technical and organizational transformations, such as the OZG implementation in Germany. For this reason, an initial EA of the FIT-Connect platform will be designed and subsequent configurative modelling techniques will be applied to provide instances of reusable reference architectures for recurring administrative service procedures, which are compatible with the FIT-Connect core architecture. This research endeavour aims at contributing to an effective and efficient implementation of the OZG regulation and to the goal of supporting the digitalization of public administrations on all federal levels of the German government.

5 Methodology

Considering the practice-oriented nature of the research subject, this thesis bases its empirical contribution on the Design Science (DS) approach within the Information Systems (IS) research discipline, previously conceptualized by Hevner et al. (2004) and further refined by Peffers et al. (2007) through their 'Design Science Research Methodology for Information Systems Research' (DSRM). These concepts of the Design Science research stream and their practicability for the research endeavor of this thesis will be described in the following.

Despite Design Science being a relatively recent research discipline, which only started to evolve in the late 20th century, prior researchers yet accomplished to postulate concise and reasonable explanations of what it is and how it can be applied to create and to evaluate solutions in order to solve identified problems (Peffers et al., 2007). By addressing the "fundamental problems faced in the productive application of information technology", Design Science combines technological with organizational perspectives and enables the creation of innovative and useful artifacts, in order to solve organizational problems (Hevner et al., 2004). Both, its problem-centered analysis and its purpose-oriented design procedures qualify the Design Science approach as a particularly suitable empirical methodology for the subject of this research.

In their publication on a DSRM, Peffers et al. (2007) provided a generally adopted framework for undertaking Design Science research, which serves as an empirical basis for this thesis. In what follows, the DSRM approach as elaborated by Peffers et al. is going to be explained in more detail, subsequently the defined methodological steps will be applied to the research subject of EAM practices within the federal administration structure of Germany.

The ultimate goal of DS research in Information Systems is to create an IT artifact in order to address an organizational problem. Further, the developed artifact should contribute to the solution of a previously unsolved and important business problem (Peffers et al., 2007). In order to achieve its goal of developing a practical, qualitative, effective contribution to a defined problem, the DSRM suggests applying a sequence of procedural design activities, which is described as a "nominal process sequence" (Peffers et al., 2007, p. 54). This thesis will focus its empirical contribution on the first three activities of the process sequence, first the identification of a problem and demonstration of its importance, second the definition of objectives for a desired solution of the problem, and third the design and development of an artifact. The following three activities of the DSRM process sequence, namely demonstration of the artifacts practicability, its evaluation and lastly, the communication of the empiric results, are not included in this research.

In what follows, three activities of the DSRM process sequence will be elaborated in further detail and their application to the subject of this thesis will be illustrated. Each of these key elements of the DSRM process sequence will be introduced based on theoretical academic contributions and subsequently incorporated in a more practice-oriented manner within the following research design section. This subject-specified derivation of the methodological steps applied to the concrete research subject of this thesis can be found in the subsequent section 'Research Design'.

5.1 Problem Identification

The first activity of the DSRM process sequence 'Problem Identification and Motivation' proposes the definition of a specific research problem and the justification of a valuable solution. Based on the problem definition, an artifact then will be designed to effectively provide a solution. Subsequently, justifying the value of the problem solution "helps to understand the reasoning associated with the researcher's understanding of the problem"

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(Peffers et al., 2007, p. 55). Within the process of problem identification, profound knowledge about the problem's state and context should be accumulated, as well as knowledge about the importance of a solution.

Applied to the subject of this thesis, namely the OZG implementation process in federal public administrations of Germany, the problem identification focuses on the heterogeneity among federated administrative entities and lacking standardization. As previously discussed, the OZG implementation faces challenges in terms of various different IT systems being operated, as well as heterogeneous organizational structures and procedures, caused by the highly decentralized and federated nature of Germany's administrative system. Building on this perception of structural and technical heterogeneity as one main obstacle towards successful OZG implementation, the developed solution must be designed to manage differing IT systems and deviating organizational structures, particularly IT architectures, information chains and administrative processes. According to the DSRM approach, this step of problem identification represents a "problem-centered initiation" of the research (Peffers et al., 2007, p. 54).

This thesis is conducted in the conviction that before one can think about an effective solution, requirements must first be formulated. Systematically determined requirements minimize the risk of developing solutions based on the wrong system. Thus, even often hidden requirements which are not immediately recognizable due to wrong assumptions, misunderstandings and political decisions can be avoided. As an example, as part of the OZG implementation catalogue, a number 576 OZG-services are subject of discussion. In fact, this number covers a much higher number of 5.000 - 6.000 LeiKa services which are differentiated in greater detail. Accordingly, requirements cannot simply be collected, but must be extracted from contexts (Hunt & Thomas, 1999).

5.2 Objective Definition

The second activity of the DSRM process sequence 'Define the Objectives for a Solution' aims at identifying criteria which a developed solution for the problem should be able to

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accomplish. Based on the problem definition, possible and feasible objectives of a solution should be rationally derived. According to the DSRM approach, these objectives can be of quantitative or qualitative nature. Accordingly, an objective may describe conditions in which a solution could work, or specify how a new artifact may contribute to the problem's solution. Prerequisites for a precise objective definition are sufficient knowledge of the problem's state, existing solution approaches and their effectiveness (Peffers et al., 2007).

Applied to the identified problem of this research, precisely the vast technical and organizational heterogeneity within the OZG implementation process in Germany, subsequently an objective definition will rationally derived. In order to solve the problem of heterogeneity as an impediment to a nation-wide and comprehensive OZG implementation, this research proposes standardizing measurements as a potential solution approach. At the core of the proposed objective of this thesis stands the development of a comprehensive IT architecture for the federated administrative system of Germany. Standardizing measurements may include consistent technical interfaces, reusable basic components and the scalable integration registries, as a basis for comprehensive EA development. According to the DSRM concept, this activity represents an "objective-centered solution" approach (Peffers et al., 2007, p. 54).

At the same time, a high degree of autonomy among network participants must be allowed, taking into account the high number of various actors who potentially may interact with each other through the utilization of public administrative services. The defined objectives therefore must unfold standardizing impacts in order to create interoperability among heterogeneous entities and systems, but at the same time must refrain from unnecessary restrictions and allow a maximal amount of autonomy for various participants to exploit their potentials. Based on prior EA- and IS research, suitable solution approaches are going to be derived from literature in order to serve the goal of a comprehensive IT architecture for the federally organized administrative system in Germany. In close correspondence with the FITKO concepts and respective EA and IS theory, explicit architectural design approaches will be selected and created as empiric core contributions of this thesis.

5.3 Design and Development

As Design Science Research places artifacts of information technology at the center of the Information Systems discipline, the third activity of the DSRM process sequence 'Design and Development' requires the creation of an artifact. Such an artifact may be a model, method, instantiation or a construct. "Conceptually, a design research artifact can be any designed object in which a research contribution is embedded in the design. This activity includes determining the artifact's desired functionality and its architecture" (Peffers et al., 2007, p. 55). Theory should be applied during this process activity, in order to move from objectives to design and development.

Applied to this thesis and the derived objective of an EA facilitating standardized transactions and components, a respective IT architecture will be designed on the basis of an architectural concept developed by FITKO. The concept is intended to serve as basis for an interoperability platform, which allows to translate information chains between differently structured systems and architectures among the federated administration structure of Germany. The designed IT architecture will be developed to illustrate the platform's intrinsic architecture, as well as its structural relations with the decentralized state architectures and their heterogeneous systems. Lastly, variants of typically occurring interactions and administrative procedures will be modeled from an architectural perspective, in order to provide reusable building blocks for configurative purposes.

The design and development activity will be based on the previously performed activities and include the application of theoretical knowledge, such as the ArchiMate EA modelling notation and other theoretical contributions of EA literature. Additionally, documentations of concepts, procedures and structures elaborated by FITKO will be investigated and included in the design and development of the IT architecture as a proposed solution approach for the challenge of OZG implementation. The following section discusses these procedures in more detail.

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5.4 Demonstration and Evaluation

According to the DSRM process sequence, the step of demonstrating the use of the developed artifact to solve one or more instances of a suggested problem is described as fourth activity 'Demonstration'. This step is succeeded by the fifth activity of the process sequence 'Evaluation', which describes the process of evaluating how well the developed artifact supports the solution of the suggested problem (Peffers et al., 2007). Due to the scope and temporal conduction period of this thesis, the fourth and fifth activity of the DSRM process sequence will be combined in order to provide an objective assessment of the created IT artifacts. Correspondingly, the 'Demonstration and Evaluation' step as part of the applied research methodology derived from Design Science, will aim at comparing the previously defined objectives of the solution to the notable capabilities of the developed artifact in the context of its implementation.

Considering that both DSRM process activities 'Demonstration' and 'Evaluation' require industry-specific knowledge of relevant factors and metrics in order to effectively analyze the value proposition of the designed artifact, the combined 'Demonstration and Evaluation' activity will be conducted in exchange with corresponding FITKO personnel through one discursive evaluation interview. More precisely, the developed architectural models will be demonstrated to and critically evaluated by one expert, who is responsible for IT architecture initiatives (FAM) within FITKO as an organization and who is dispositive for the creation of the FIT-Connect platform concept and its federal administrative integration. This process step will pay particular attention to the artifacts' functionality compared to the solution objectives formulated within the second process activity 'Objective Definition'. The aggregated results of the 'Demonstration and Evaluation' process activity will then serve as a basis for an iterative adaption of the models, subsequent reflection and summary of the scope, relevance and quality of this research and its contributions.

6 Research Design

Guided by the previously elaborated theoretical concepts of Design Science, the present section contains the empirical contributions of this thesis. As described in the course of the research proposal, the generally intended properties of the FIT-Connect platform have been analyzed and derived from legislative groundings such as the OZG and operational concepts provided by FITKO. As a consecutive step, the explained empirical design process will be exerted in order to create EA models of FIT-Connect as an architectural IT artifact in the sense of Design Science.

Guided by principles of Design Science research, this section explicitly presents the empiric contribution of this thesis following the empirical approach of the DSRM. Four methodological steps will be carried out in order to create an IT artifact as a solution proposal for the derived research gap. The four steps ‘Problem Identification’, ‘Objective Definition’, ‘Design and Development’ and ‘Demonstration and Evaluation’ are applied to each partial contribution of this research, addressing the development of an IT architecture for Germany’s federal administrative system in the context of the OZG implementation. The research contribution itself will be presented in separately elaborated artifacts.

More specifically, the overall IT architecture of the FIT-Connect platform concept will be developed and modelled as one first IT artifact, incorporating the platform architecture’s core components, its stakeholders and other dimensions of the platform’s ecosystem. Secondly, the platform’s interface design will be addressed individually with particular attention. This approach has been selected on the basis of corresponding literature analysis, which suggests that a platform’s interfaces are among the most essential components of platform ecosystems in order to formulate an ecosystem’s constraints and binding requirements. Third, this research is going to create stakeholder-specific architectural views on the FIT-Connect platform, presenting their different business processes and application structures, but also stakeholder’s individual requirements, constraints and drivers motivating their operations and their functions on the platform.

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Each of these artifacts will be based on Design Science theory in the form of DSRM application by identifying a problem, formulating respective objectives that should be addressed in order to solve the problem, by the creation of IT artifacts in the form of architectural models, which explicitly represent the process of design and development. Additionally, these procedures are supported by EA literature on platform architectures, FITKO documentations and concepts and lastly the application of the ArchiMate modelling notation. Lastly, the developed architectural models will be evaluated according to the DSRM approach, which will allow an objective assessment of the research contribution of this thesis.

To conclude, the research design of this thesis is intended to represent the elementary and specific properties of the FIT-Connect platform, to serve as a blueprint for the project's further development and integration, as well as to illustrate its structure and integrational functions between different organizational dimensions among Germany's federated administrative system. This attempt is guided by the understanding of EA's intend to reduce the complexity of its underlying system by decomposing it into different parts that collaborate in order to achieve a functioning whole which is capable of adapting to changing requirements, technologies and developments in its external environment.

6.1 Platform Architecture

Based on the FITKO concept of FIT-Connect, a first version of the FIT-Connect platform architecture will be developed within this section. Based on this architecture, one will investigate how the decentralized state architectures are related to the platform in the federal administrative context. Using the ArchiMate (2010) EA modelling notation, a model of the IT architecture of the FIT-Connect platform will be created. The models are based on conceptual information from documentations of FITKO operations and through exchange with FITKO personnel. First, the developed platform architecture will be introduced and described with ArchiMate models, subsequently more attention will be brought to the design of the platforms interfaces, as they represent central instances of FIT-Connect's design and governance. The platform architecture dimension of this research's empirical contribution bases its procedures on literature addressing platform ecosystems and platform architecture, as well as ArchiMate modelling literature.

Platform ecosystems aim to establish a difficult balance between control and autonomy (Iansiti & Levien, 2004, p. 5). Platform architecture can balance the need for independence of external developers and simultaneously integrate the autonomously developed contributions and solutions into a continuous ecosystem. According to Tiwana (2014), platform ecosystems fulfill two central functions: partitioning and system integration. "Partitioning refers to a decomposition of the ecosystem such that each subsystem in it is relatively autonomous from others. […] The primary function of architecture is to provide a framework to decompose a complex ecosystem into relatively independent subsystems" (Tiwana, 2014, p. 80). This view of partitioning corresponds with the earlier described function of complexity reduction in the field of Enterprise Architecture and represents a desired property for the FIT-Connect platform architecture. A method of reducing the complexity of a system and increasing its comprehensibility is to decompose it into separate components. These fragments can then cooperate with each other to achieve the intended functionality. A partitioned architecture specifies how the components of a system interact, but not how they work in detail (Tiwana, 2014). This method of partitioning can also be described as modularization.

Partitioned subsystems of a comprehensive platform architecture enable innovation to be delegated across various external parties that develop contributions to the platform ecosystem. Each component can be implemented by independent entities, acting for varying causes and shaped by different expertise. Market-driven dynamics then prefer the valuable solutions over the less convincing applications, which cannot compete. In this manner, the responsibility to drive innovation is transferred from the platform initiator to external application developers. In an optimal scenario, this leads to a collective leverage of innovation practices exceeding the capabilities and resources of the platform owner by a multiple. Dividing complexity through a platform architecture thus enables numerous independent actors to provide parts of a larger ecosystem while assuring that the distinct parts integrate consistently (Tiwana, 2014).

Another benefit of the modularization approach for the FIT-Connect platform architecture lies in preventing external developers from an unnecessary information overload: contributors of distinct work packages do not need to be aware of every detail of the platform logics and its correlations. In return solution developers can focus extensively on their own essential objectives, without the need to understand the details of the operational structures on which their solution is based (Tiwana, 2014). The second central function of platform architecture describes Tiwana (2014) as ‘systems integration’. “Systems integration refers to coordination of development activities among app developers and the platform owner. Systems integration capability of a platform is a platform’s capacity to combine the different competencies of app developers with those of the platform” (Tiwana, 2014, p. 82). Enabling the integration of various systems into the demands of an overarching ecosystem is therefore of significance when utilizing the potentials of external parties. By defining relationships and interactions between complements and the FIT-Connect platform, the architecture can perform underlying coordination functions.

As elaborated in more detail within the section addressing FIT-Connect concept developed by FITKO, the platform architecture focuses on integration of complementary services through interfaces. This approach is intended to encourage the development of a self-evolving market-driven ecosystem around the platform. While public administrations as governmental institutions find themselves positioned in different competitive environments than private corporations, they yet are not excluded from the necessity to develop and adjust their strategies to external challenges. Architectural design decisions therefore must pose a clear demarcation of what responsibilities can be performed by external actors and which must be maintained by public authorities. External actors developing products and services within the framework of the FIT-Connect ecosystem may possess skills, capabilities and understandings of citizen needs that governmental actors and platform owners do not.

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The FIT-Connect platform architecture modularly represents the complex federal administration system in Germany. In the sense of platform architecture according to Baldwin and Woodard (2008), selected architectural components remain stable, while complementary elements are encouraged to change in order to enable platform-based innovation. Following established concepts of platform architecture, the FIT-Connect architecture is defined as “a set of stable components that supports variety and evolvability in a system by constraining the linkages among the other components” (Baldwin & Woodard, 2008, p. 3). The approach of developing reusable basic core components enables scalability within an ecosystem, while reducing the cost of creating a variety of more flexible complementary components. In this sense, it is essential to define which components must remain stable and which components should be able to vary. Respectively, the FIT-Connect platform architecture is designed to provide a modularity divided into a set of components with low diversity and high reusability and a set of components with high diversity and low reusability.

This categorization allows the FIT-Connect platform architecture to be evolvable and to react to unanticipated changes in its external environment. This is to be achieved by minimizing the interdependence of modular, robust and flexible components within the architecture. Correspondingly, the entire system does not need to be fundamentally re-developed or restructured in order to create new products and services, in occurrence of different requirements and changes in the external environment (Baldwin & Woodard, 2008). An evolvable FIT-Connect platform architecture can be adapted in a cost-effective way without losing its integrity or continuity. Referring to the categorization exercised by Baldwin and Woodard (2008) within their contribution to platform architecture in IS research, the architectural design within this thesis divides modelling elements into three types of components: “(1) the complements, which exhibit high variety and high rates of change over time; (2) the core components, which remain stable as the complements change; and (3) the interfaces, which are the design rules that allow the core and the complements to operate as one system” (Baldwin & Woodard, 2008, p. 20). The type 1 ‘complementary’ elements refer to components contributed by external actors as part of the platform ecosystem, while type 2 'core components' and type 3 'interfaces' are robust and integral elements of the platform architecture provided by the platform owner. Wierda (2017) applied a similar distinction between architectural elements in platform ecosystems, categorizing the modelling of platforms into primary, secondary and tertiary architectures.

Considering the higher complexity of platform architectures compared to the initial focus of 'conventional' Enterprise Architectures to support business processes by IT applications, the platform architecture of FIT-Connect is required to consider significant additional dimensions, such as ownership and role-specific responsibilities. For this purpose and in accordance with Wierda (2017), a categorization of architectures was applied to the modelling initiatives of this thesis, in order to illustrate various perspectives of different roles and domains within the FIT-Connect concept, such as the platform control and ownership, the system's maintenance and responsibilities addressing separate services or applications, in addition to its primary business cases, such as service development and service provision. An overview of the FIT-Connect platform architecture is provided by the following model and a more detailed elaboration will be carried out subsequently.

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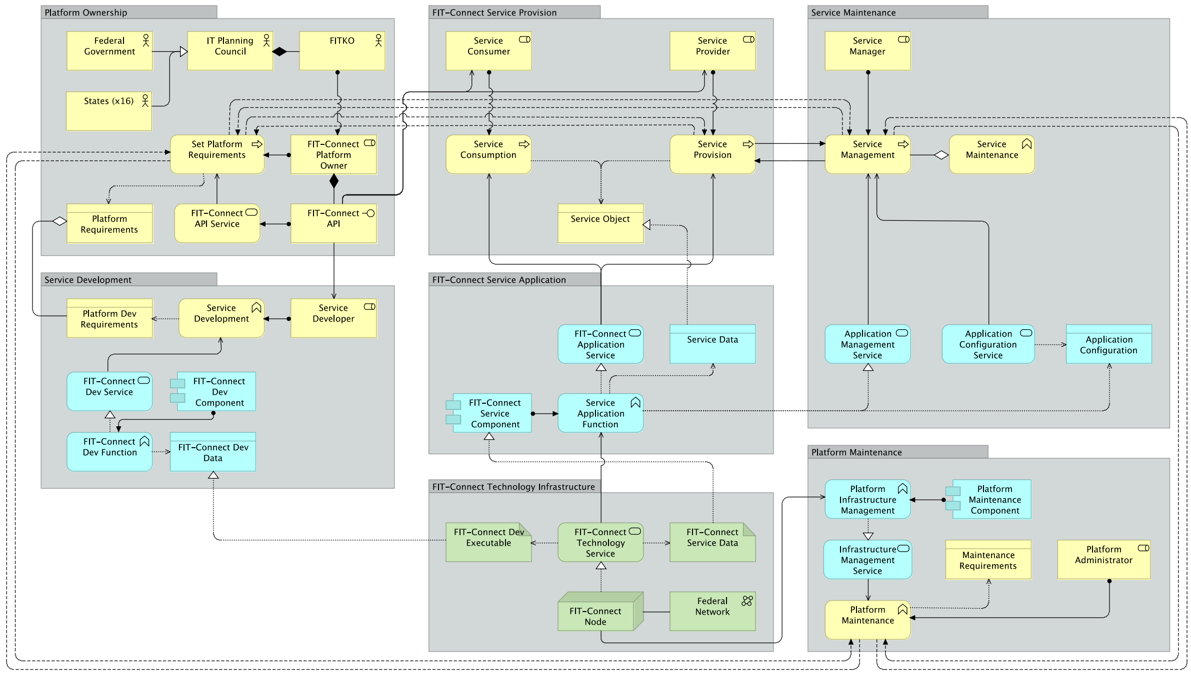

Figure 3: FIT-Connect Platform Architecture

The primary architecture of the FIT-Connect platform comprises the business-, application- and technology layers of the model. The three layers of the primary architecture are illustrated by the grouping elements named *FIT-Connect Service Provision*, *FIT-Connect Service Application* and *FIT-Connect Technology Infrastructure*. Also, the *Service Development* dimension is part of the primary architecture of FIT-Connect. The secondary architecture of the FIT-Connect platform consists of the platform's maintenance and the maintenance of particular services. The grouping element *Platform Maintenance* incorporates structures and procedures dedicated to the maintenance of the general system, while the grouping element *Service Maintenance* is dedicated to structures and procedures supporting service- and application-specific domains of FIT-Connect products. The tertiary architecture according to the Wierda (2017) categorization addresses the ownership dimension of the FIT-Connect platform, which describes the proprietary aspects of the architecture, such as the definition of requirements and constraints regarding other dimensions of the platform architecture and ecosystem. Following, each of the mentioned architectural dimensions will be addressed into detail with regard to their semantics, their setup and their role in the overall context of the

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FIT-Connect concept. Furthermore, it will be elaborated on how the design- and modelling decisions taken within this thesis are grounded on established EA research practices and principles.

Regarding the primary business case of FIT-Connect, the dimension illustrated by the group *Service Provision* represents the core business structure of the platform, visualizing the provision and consumption of administrative services. Both roles *Service Provider* and *Service Consumer* can be taken over by civil, corporate, or public entities: Service provider may be a private actor willing to offer a service within their corporate business model. Alternatively, also the business actors *Federal Government*, one of the 16 German *States*, or *FITKO* can be assigned to the *Service Provider* role. Same applies to the role *Service Consumer*, which as well could be taken over by civil or corporate entities, such as citizens, enterprises, or associations. As declared within the FIT-Connect concept, the development of services by various actors is alongside with the provision and consumption of services, the second essential pillar of the platform. Accordingly, the *Service Development* dimension was modelled as an additional part of the primary architecture of the FIT-Connect EA. Both dimensions *Service Development* and *Service Provision* are desired to be respectively supported by the platform's application- and technology layer. Assuming a service application for FIT-Connect is developed by the Federal Government, the FITKO, or by State Government through the *Service Developer* role, this development process happens to be a business process itself within the *Service Development* dimension. Same applies in case of a service application being developed by external actors or externally purchased. Hence, the *Service Development* process was modelled as a separate business process alongside the *Service Provision* and *Service Consumption* business processes. Each of them is served by a respectively designed application support, visualized through the blue-colored structural and behavioral application elements in the model. The application support for *Service Development* and *Service Provision* is comprised of respective application components assigned to specific application functions, accessing respective data objects for their purposes and realizing an application service, which serves the business process. The *FIT-*

Connect Technology Service on the platform architecture's technology layer serves both the *Service Application Function* and the *Service Development Function*. The respective application component elements assigned to the application functions for service provision and service development are realized by their dedicated artifact elements *FIT-Connect Service Data* and *FIT-Connect Dev Executable*. The executable file on the technology layer of the platform architecture represents the basis of data provided by the *FIT-Connect Node* to employ the *FIT-Connect Dev Component* application element which is an application supporting the *Application Development* function, which then realizes the *FIT-Connect Dev Service* application element serving the *Service Development* business function exercised by the *Service Developer* business role.

As part of the secondary architecture with regard to the categorization of EA dimensions proposed by Wierda (2017), the *Service Maintenance* group within the platform architecture model illustrates an important aspect of the service- and application management within the FIT-Connect ecosystem. All service maintenance and application configuration issues are being handled within the secondary platform architecture and more precisely within the *Service Maintenance* dimension. These procedures are summarized through the *Service Management* business process, to which the *Service Manager* role is assigned. Comparable to the *Service Provider* and *Service Developer* roles in the primary platform architecture, the *Service Manager* role can be taken over by public, corporate or even civil entities. As it is generally applicable in many organizational complex constructs, services and applications offered on the FIT-Connect platform can cooperate with many various service- and application managers, taking over the responsibility for tasks such as configuring application settings, authorizations, maintenance and/or reporting activities, tailored to the specific service or application purpose. Serving the modularization approach of platform architectures proposed by Tiwana (2014), services and applications provided and developed on top of FIT-Connect can be created by various different participants. Same applies to the maintenance of services and applications. This is of particular importance, if services or applications are designed by external entities such as corporate companies, since the

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developer of a platform may very likely as well be predestined for its maintenance and therefore might be the most appropriate business actor to take over the role of the *Service Manager*. The *Service* Management business process is served by two respective application services, namely the *Application Management Service*, which is realized by the *Service Application Function* located in the primary platform architecture of FIT-Connect and additionally by the *Application Configuration Service*, which obtains access to the *Application* Configuration data object application element. Finally, the *Service* Management process has been modelled as being part of the overall *Service Maintenance* business function, indicating that service management addresses a specific service or application, while generally service maintenance must be executed for all individual services and applications deployed by distributed platform participants. Obviously, also externally organized service- and application managers must comply with the platform requirements postulated by the platform owner, which is indicated by the reciprocal flow relation between the *Set Platform Requirements* business process element executed by the *FIT-Connect Platform Owner* role and the *Service Management* business process. The *Platform Ownership* dimension and its essential proprietary role in the framework of the FIT-Connect platform architecture will be elaborated subsequently.

Finally, also the *Platform Maintenance* dimension is part of the secondary platform architecture and describes the technical and infrastructural capabilities of the FIT-Connect platform. The *Platform Administrator* business role may be taken over by the FITKO itself, or outsourced to an external corporate entity. The first priority of platform maintenance is to ensure the technical and infrastructural necessities and requirements for the applications to function as intended. The applications may be initially deployed on the *FIT-Connect Node* as part of the *FIT-Connect Technology Infrastructure Dimension*, but the *Platform Maintenance* dimension ensures that the infrastructure runs according to the necessary system requirements. Also, the *Platform Administrator* serves as a contact entity for service- and application managers as part of the *Service Maintenance* grouping element. Comparable to the *System Maintenance* dimension, also the *Platform Administrator* role is assigned to a dedicated *Platform Maintenance* business function, which is supported by an *Infrastructure Management Service* application element and obtains access to a *Maintenance Requirements* business object. The *Platform Infrastructure Management* application function is connected to the *FIT-Connect Node* and is part of a *Platform Maintenance Component* application element.

As previously described, platform architectures have the potential to reveal valuable capabilities and resources by providing distributed platform participants the opportunity to contribute to the platform's value by developing business models and services on top of it. In order to maintain interoperability within various applications and services developed and provided by distributed entities, it is crucial to motivate a harmonic development of the platform's ecosystem by setting binding requirements and constraints for all activities taking place on the platform architecture. With regard to the case of the FIT-Connect platform architecture, this distinct organizational construction is modelled through the tertiary platform architecture dimension, which is represented by the *Platform Ownership* grouping element. Taking into account the federated administrative system of Germany and its digitalization initiatives, the platform ownership as well reflects this decentralized structure: the *FITKO* business actor is composed of the *IT-Planning* Council business role, which in return is derived from the specialization of the *Federal* Government business role and each 16 *State (x16)* business roles. The *FITKO* business actor therefore is indirectly aggregated from the Germany's Federal Government and each of Germany's 16 States and then assigned to the *Platform Owner* business role. This business role is assigned to the *Set Platform Requirements* process, representing the platform owner's function of postulating the platform's requirements and constraints for developing, providing and maintaining services and applications on the FIT-Connect platform. As an output of the *Set Platform Requirements* business process, the business object element *Platform Requirements* is generated, representing the FIT-Connect requirements and constraints as universally valid and binding measures for all activities on the platform. This circumstance is also illustrated by the *Set Platform Requirements* business process being related via flow relations to the

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Service Provision, *Service Management* and *Platform Maintenance* processes and functions. Lastly, also the *FIT-Connect API* business interface element is composed of the *Platform Owner* role and is assigned to the *FIT-Connect API Service*, which serves the *Set Platform Requirements* process and the respective processes and functions within the other associated dimensions of the FIT-Connect platform architecture. The function of APIs as constraining and controlling bottle necks within a platform architecture will be described in detail within the following section.

To summarize, this section addressed the platform architecture design based on the FIT-Connect concept. First, the platform approach to EA has been elaborated according to established IS research on platform ecosystems, such as publications by Iansiti and Levien (2004), Baldwin and Woodard (2008) and Tiwana (2014). These steps were taken in order to motivate the promising potential of platform architectures fostering emerging ecosystems around them. Additionally, the approach proposed by Wierda (2017) to categorize different architectural dimensions into primary-, secondary- and tertiary architectural groups was incorporated to the platform architecture design process of this thesis, in order to replicate the organizational complexity of the FIT-Connect concept and to respond to the various perspectives involved in the platform's structure and processes. These derived implications where taken into account within the design phase and model creation for the FIT-Connect platform architecture. Subsequently, the design decisions made were translated into an ArchiMate model of the FIT-Connect platform architecture making use of the categorization approach according to Wierda (2017). Structures and procedures modelled were explained in detail and the different perspectives and requirements to a functioning FIT-Connect EA were illustrated. I what follows, the interface technology applied within the FIT-Connect EA as one of its most essential elements will be explained in further detail. Additionally, more specific views on the architectural dimensions from the perspectives of different stakeholders in the FIT-Connect ecosystem will be developed in the following sections.

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6.2 Interface Design

The central component of the FIT-Connect platform architecture is its modular reusable interface (API), which mediates between the platform and its extensions. Similar to other platform architectures, the APIs are the most stable part of the architecture affecting all its other elements, thus control over the interfaces is equivalent to control over the entire platform and its configuration. This section addresses the theoretical implications for interface design within platform architecture and subsequently applies them specifically to the development of the XFall RESTful API for the FIT-Connect platform architecture.

The interfaces define the rules for the interaction between the different parts of the platform architecture and restrict the dependencies between components to obey the interface specifications. All interaction between the platform and the applications is performed through its interfaces. They provide all complementary components with the necessary information to access the platform's services and functions needed fulfill their tasks. The interfaces also contain documentations of the protocols used to describe interactions between FIT-Connect and its applications. Consequently, the interfaces enable and, where necessary, restrict communication between the platform and the applications (Tiwana, 2014). "An API can include specifications for variables, routines, data structures, protocols, and object classes and behaviors. These APIs provide app developers well-defined means to access the platform's shared libraries, protocols, functions, and specific capabilities that they can use as a starting point for implementing their apps" (Tiwana, 2014, p. 112).

Interfaces are an essential element of platform architectures with significant strategic relevance. In fact, interfaces mediating between hardware, software and other architectural layers in information systems tend to last much longer than their hard- and software implementations. This indicates that the true ownership of a platform belongs to the entity which is in control of the interfaces, as they are the most stable architectural components enforcing their constraints on all other components of the system (Baldwin & Woodard, 2008). The interface design intends to create stable but yet versatile interfaces that can integrate types of relationships which may not have been anticipated at the time the of platform architecture development. The interfaces control the communication of the components and assign access permissions to regulate which functions are allowed to interact with other functions in which ways. Interfaces serve the function of a bridge between a platform and the apps in the platform ecosystem. They represent the publicly accessible information of the platform and ensure compliance with fundamental rules for technical interoperability (Tiwana, 2014). FITKO has documented all information on how to communicate and interact with the FIT-Connect interface in text form and made it publicly available. Any interaction between platform and applications must be performed through the interfaces.

The platform is openly designed to allow third parties to access the information through interfaces and to create complementary applications that extend the platform. Open and standardized platform interfaces are essential for opening up the platform architecture. As an open platform is crucial for its ecosystem to emerge, FIT-Connect's interfaces are precisely documented, publicly available and subject to property restrictions. If the German governmental actors clearly and explicitly communicate how external entities can build on the FIT-Connect's properties in their contributions, this may foster significant and broad innovation around the platform. The interfaces must be flexible in order not to excessively restrict external complementary additions and not to reduce the diversity and innovative power of the ecosystem. The interfaces are central intersections of the platform architecture between platform owners and external complementary contributors, centrally governing all interactions in favor of the platform owner's intentions. If implemented correctly, the API design can spark a simply to apply 'plug-and-play' interoperability within the ecosystem and unfold lasting network effects by setting industry standards in its segment.

In consultation with the FIT-Connect documentations elaborated by FITKO, this section describes and represents the technical interface properties of the XFall RESTful API design of the platform. Combined with the FIT-Connect platform, the XFall RESTful API enables solution developers and developers of OZG procedures to efficiently integrate their

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applications into application processes without technical discontinuities. As derived previously, solution providers and developers are intended to be relieved of recurring integration requirements and are able to focus their capacities on promoting innovation in public administration and on delivering user-centric solutions for applicants and public servants. The XFall RESTful API builds on previous concepts and experience of the XFall interoperability standard developed by the IT Planning Council. The primary objective of XFall is to transfer applications and reports that are created from existing systems (e.g. online application services, administration-specific portals or reporting systems) to the corresponding electronic application processing systems within the federated administration landscape. Based on this requirement, the XFall RESTful API consists of two dedicated APIs for senders 'Application Sender API' and receivers of applications 'Application Subscriber API'.

The XFall RESTful API concept was developed with regard to the new requirements of the OZG, corresponding EU regulations and the demands of contemporary digital business models. As a result, the XFall RESTful API is based on a 'Representational State Transfer' (REST) architecture style and provides a connection to the FIT-Connect platform and its uniform federal integration and development infrastructure. The RESTFul API typically fits into the partitioned modular concept approach of platform architecture by specifying the solely location and name of the resource in the web application - but not the functionality which the web service offers for the retrievable resource.

In this manner, the FIT-Connect platform provides suitable APIs for stakeholders and resolves many integration issues centrally through its specified interaction constraints. The transmission processes of applications and data follow the 'Lightweight Messaging Principle', meaning that no administrative-specific logics are carried out by the platform itself, but the responsibility lies with the respective recipient or corresponding administrative unit. Additionally, the delivery logics remain transparent for senders, e. g. citizen or organization. The FIT-Connect developer portal provides users with all information and resources for connecting to the XFall RESTful API. In addition to centrally created information and tools, information that was previously only decentrally available, is to be grouped and linked in order to reduce the effort to retrieve critical information. At present, interested organizations and projects are given access to the API portal and are able to prototypically integrate procedures. The long-term productive deployment of the XFall RESTful API depends on the further development of the FIT-Connect platform.

The integration platform of FIT-Connect provides two central components, which provide their functions through the XFall Delivery Service [XFall Zustelldienst]. The XFall Delivery Service incorporates the Application Sender API and Application Subscriber API. An API Gateway exercises access controls both APIs of the XFall Delivery Service (e. g. authorization, rate-limiting, security checks, etc.) and provides authentication for API access in interaction with a connected Identifier Management Component. The API Gateway is not immediately visible for API clients within their API usage. The integration architecture requires that receiving administrative authorities or service providers initially create a delivery point for applications with a unique Destination-ID using the Application Subscriber API. The Destination-ID is to be exchanged bilaterally with the application sender or communicated through an approved channel. The ID is then used by the sender within the Application Sender API to address the correct administrative entity and to submit the application to the corresponding delivery point. The receiving authority or service provider can then retrieve and process the application with their preferred systems.

In the longer term, the Destination-IDs are to be published through the present responsibility finders, which are already established on the federal- and state-administrative level. This will provide a scalable approach allowing application services to obtain the Destination-IDs from the administrative departments directly through responsibility finders. This approach will eliminate the necessity of resource-intensive individual agreements during the development phase. Instead, the application services will be able to utilize an universal responsibility-based approach based on existing federal basic infrastructures. Furthermore, the XFall Delivery Service will transmit all relevant data relevant, such as copies of the application data or status information, to the applicant at triggering events (e.g. entry to the delivery service or collection at the delivery point). This will relieve the application services and other administrative procedures from this task. Interoperable mailboxes are to be made available in the future to serve a standardized transmission path between applicants and administration. Lastly, the XTA standard for data transmission is established in numerous departments of the German administration and is applied to connect transport procedure of applications through protocols and communication infrastructures. Considering its wide adoption among administrative agencies, XTA components are to be fully supported when connecting to the XFall RESTful API.

Please note that not all the described features could be considered in the following model of the XFall RESTful API architecture, since not yet all planned features have been finally developed. Nevertheless, the following model represents the conceptualized open RESTful API, which provides access to FIT-Connect integration components and development resources.

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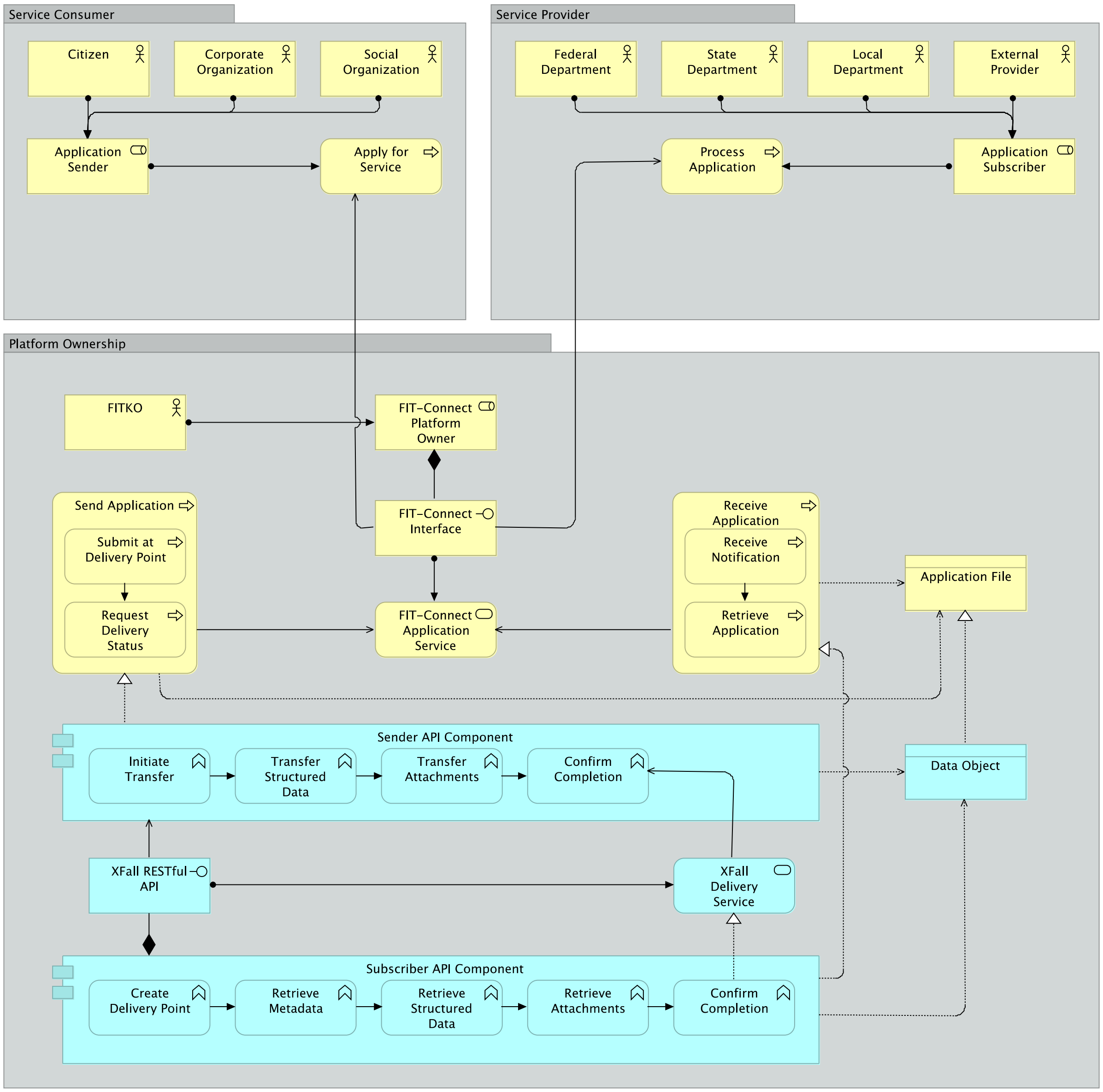

Figure 4: Platform Interface Architecture

The ArchiMate model above represents the architecture of the FIT-Connect application interface, which is the platform's core component. As displayed on the yellow business layer of the model, business actors assigned the role *Application Sender API* users can be civil, corporate or social entities. The same semantics apply to the business actors in the role assigned to the *Application Subscriber API* role, which can be Federal-, State-, or Local administrative entities with regard to the decentralized federal levels in Germany's administration. Additionally, corporate or civil actors may also take over the *Application*

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Subscriber role, as indicated by the *External Provider* business actor element. FITKO on behalf of the IT-Planning Council takes over the role of the *FIT-Connect Platform Provider*, which incorporates the FIT-Connect interface. The FIT-Connect interface serves both the roles of the *Sender API* user as well as the *Subscriber API* user and is assigned to the *FIT-Connect Application Service*. The *Send Application Process* is comprised of the sub-processes *Submit at Delivery Point*, referring to the application sender delivering an application at a previously defined spot. Also, the *Send Application Process* incorporates the sub-process *Request Delivery Status*, referring to the possibility of an application sender to request the current status of his or her application. The *Send* Application business process is realized by the *Sender API Component* on the application layer. The *Receive Application Process* is comprised of the sub-processes *Receive Notification*, referring to the application receiving system to receive a notification triggered by an application being transmitted. Additionally, the sub-process *Retrieve Application* is triggered by the previous business sub-process. The *Receive Application* business process is realized by the *Subscriber API Component* on the application layer. The API application components interact through the *XFall RESTful* application interface element and the *XFall Delivery Service*. Furthermore, the application components access the *Application Data Object*, which then realizes the *Application File* on the business layer. The *FIT-Connect Application Service* on the business layer can then be used by the business processes performed by the *Application Sender* and *Application Subscriber* business roles to execute their individual administrative procedures.

The *Sender API Component* application element contains the application functions *Initiate Transfer*, *Transfer Structured Data*, *Transfer Attachments* and *Confirm Transfer Completion*. The *Subscriber API Component* application element contains the application functions *Create Delivery Point*, *Retrieve Metadata*, *Retrieve Structured Data*, *Retrieve Attachments* and *Confirm Completion*. The application functions of both application components represent the application-logical capabilities on both the *Application Sender* and the *Application Subscriber side*. Both application components access the respective data objects, referring to an applications metadata, application ID and delivery ID, structured XAV data referring to the previously mentioned XAV standard data format, as well as an application's relevant attached files. The data object on the application layer realizes the business object *Application File* on the business layer, as denoted by the realizing relation.

Through the construction of the *XFall RESTful API* architecture, all stakeholders are enabled to interact with the FIT-Connect platform according to their individual administrative business processes. FITKO assigned to the role of the platform owner maintains control over the application layer by enacting its platform-specific constraints and requirements through the application interface. Stakeholders can act on the platform and interact with other business actors through the application interface, which also enables access to relevant data objects and business representations. Business processes executed by other business roles than the *Platform Owner*, can access the business object element *Application File*, which contains all relevant information with regard to an application.

6.3 Motivation Model

Besides the FIT-Connect platform architecture and its interface design, the focus of this thesis lies on its configurative aspects representing how different stakeholders interact with the FIT-Connect platform. Exemplary interactions addressed within this section are applications submitted towards the administration (i.e. submitted by citizens or businesses) or the receiving and processing of applications by the administration. Similar to the various dimensions of the FIT-Connect platform architecture elaborated previously, also the perspectives of application- and service developers will be subsequently considered, as well as the aspects of platform- and service provision. Each of these stakeholder perspectives will be represented by the design of corresponding views, which aim to provide a detailed description of the stakeholders' business- and application structure and their motivational situation, affecting their way of interacting on and with the FIT-Connect platform architecture.

Considering the extensive complexity and scope of Germany's federated administrative structure and its respectively large variety of procedures, not all dimensions of

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administrative business can be included in the scope of this thesis and are therefore potential subjects of further research. Instead, this thesis focuses on a motivation model representing the intentions of central stakeholders of the FIT-Connect platform and a selection of stakeholder views describing exemplary interaction scenarios for the FIT-Connect platform architecture. The following examples may prospectively serve as a basis for more detailed and more specified individual case studies of interactions on the FIT-Connect platform in the course of its further development. In total, a number of four different stakeholder views will be created as part of the research contribution of this thesis in the following section, based on the general motivation model. The stakeholder views include the four following perspectives: *Platform Owner, Service Developer, Service Provider* and *Service Consumer.* Except the platform ownership perspective, each other stakeholder role can be carried out by an administrative entity, a corporate entity, or a civil entity. Other stakeholder perspectives previously mentioned in the platform architecture model, namely *Platform Maintenance* and *Service Maintenance*, are not included in the motivation model and the specific stakeholder views.

Building on the motivation model, the stakeholder views will include not only the stakeholder-specific business- and application structures, but also the motivational factors affecting their behavior on the FIT-Connect platform. In order to do so, this section employs the ArchiMate motivation extension (2010) in addition to the business- and application layers of the architectural models. As described within the section directed to the ArchiMate modelling notation previously within this thesis, the motivational concepts allow to illustrate underlying reasons and motivations of Enterprise Architecture, which influence, drive and constrain its design. The motivation extension of the ArchiMate notation introduces motivation- or intention elements, such as goals, principles, requirements, or constraints and the sources of such intentions, such as stakeholders, drivers, or assessments. As the purpose of motivation elements to model the motivation behind core elements in an EA, they generally can be linked to the core elements of the ArchiMate notation through an influence relationship, which may be denoted as a positive or a negative type of influence (Wierda, 2017). Structural and behavioral elements can be linked with the motivation extension by means of a realization relationship in combination with a requirement motivation element (Archi, 2010). This syntax is applied and displayed in the motivational view of the FIT-Connect platform architecture below.

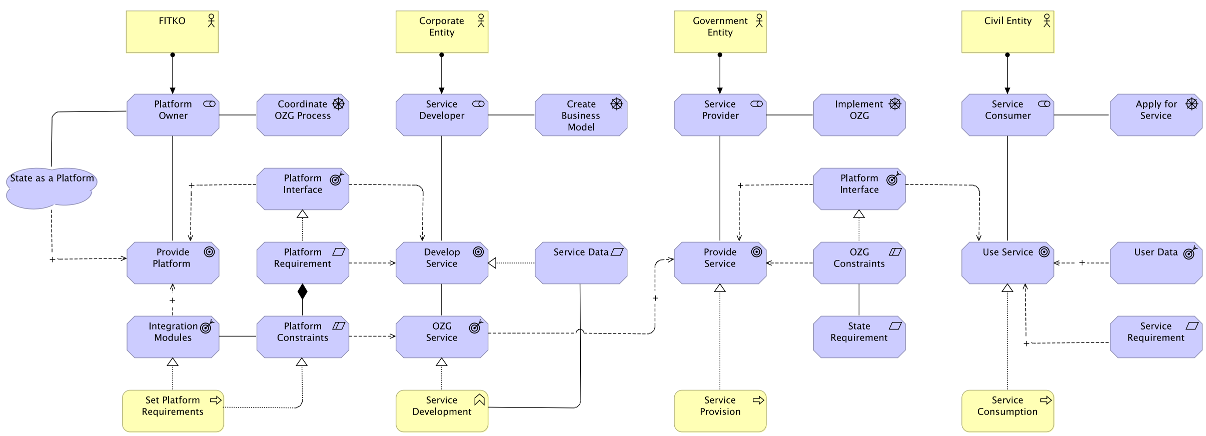

Figure 5: FIT-Connect Motivation Model

The ArchiMate model above represents the motivational perspectives of four essential stakeholders within the FIT-Connect ecosystem: *Platform Owner, Service Developer, Service Provider* and *Service Consumer*. In the presented model, one can identify the four business role elements *FITKO, Corporate Entity, Government Entity* and *Civil Entity* being assigned to the motivation stakeholder elements. Please note that within the FIT-Connect ecosystem, the *Corporate Entity* role as a private enterprise may be considered likely to take over the role of a service developer and therefore be assigned to the *Service Developer* stakeholder element. But a private enterprise may at the same time also be interested in taking over the role of a service provider on the platform, or as well may be urged to take over the role of a service consumer. Therefore, the *Corporate Entity* business role may also be assigned to the *Service Provider* and the *Service Consumer* stakeholder motivation elements.

Same applies to the *Government Entity* business role, as federal administrative government departments are likely to be interested in developing their own service complementing their administrative procedures. In that regard, the *Government Entity* business role may as well be assigned to the *Service Developer* stakeholder motivation element. Lastly, the *Civil Entity*

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business role, for instance a citizen or social organization, may develop or provide an individual service on the FIT-Connect platform. For this reason, the *Civil Entity* business role may as well be assigned to the S*ervice Developer* or the *Service Provider* stakeholder motivation element. While these semantics are of high importance for the platform model and its effects on a developing ecosystem to unfold, they are not modelled within the motivation architecture presented above. This decision was made for conciseness reasons, in order to maintain the model in a clear arrangement and structure. Nevertheless, the optionality for the different business roles to take over several additional stakeholder roles is vital, since individual administrative entities may possess the highest amount of competence to develop or provide a service for their respective administrative procedures compared to a corporate entity, which in many cases may not be aware of administration-, legislation-, or region-specific environmental factors. In other cases, the situation might be the other way around and a private enterprise may be predestined not only to develop a certain service, but also to provide the service to its customer base whose preferences and concerns it knows best, as well as how to address them.

Moving over to the more detailed semantics of the motivation model, the *Platform Owner* stakeholder motivation element is associated with the *Coordinate OZG Process* driver motivation element and the *State as a Platform* meaning motivation element, illustrating the overarching strategic intentions of the FITKO as FIT-Connect platform owner, supporting the strategic goal of administrative digitalization and the platform concept. Correspondingly, the *Platform Owner* stakeholder element is associated with the *Provide Platform* goal motivation element, simply expressing FITKO’s goal of providing the FIT-Connect development- and integration platform to solution developers and administrative actors responsible for OZG implementation. The *Provide Platform* motivation elements as the prior strategic goal of the platform owner is positively influenced by three other elements. First, the *State as a Platform* meaning element generally motivates the goal of the platform owner. In a more specific sense, the *Provide Platform* goal motivation elements is positively influenced by two key requirements of the goal to be achieved: The *Platform Interface* and the *Integration*

Module motivation elements, which have been modelled as outcome elements, since they represent tangible results affecting the goal, which can be regarded as a desire of providing a platform. The *Set Platform Requirements* business process element realizes the *Integration Module* outcome motivation element directly and transitively realizes the *Platform Interface* outcome motivation element through the *Platform Constraints* constraint motivation element, which is composed of the *Platform Requirement* motivation element, which then again realizes the *Platform Interface* outcome motivation element.

Regarding the *Service Developer* stakeholder motivation role, it is associated with the *Create Business Model* driver motivation element, assuming that one major incentive for private corporations to develop service on the FIT-Connect platform is anticipated to be a prospective market opportunity. The driver element obviously would be required to change accordingly, in case another business role element (e.g. *Government Entity* or *Civil Entity*) would be assigned to the *Service Developer* stakeholder role. In the presented model however, the *Service Developer* stakeholder role is taken over by the *Corporate Entity* business actor and therefore motivated by business-driven interests. Furthermore, the *Service Developer* stakeholder motivation role is associated with the *Develop Service* goal motivation element, as service development my most likely be the prior goal of a service developer on the FIT-Connect platform. The *Develop Service* goal is directly influenced by *Platform Requirement* motivation element and the *Platform Interface* outcome element, as both are intrinsically designed to influence and shape the development of services on the FIT-Connect platform. The *Service Requirement* motivation element directly realizes the *Develop Service* goal, indicating the significance of the individual business requirements for the development of services. Moreover, the *Business Requirement* motivation element is directly realized by the *Service Development* business function, which is executed by the *Service Developer* business role and directly realizes the *OZG Service* outcome motivation element associated with the *Service Development* goal element and influenced by the *Platform Constraint* motivation element.

Moving over to the *Service Provider* stakeholder motivation element, which in the given example is taken over by the *Government Entity* business role representing any public administrative entity within Germany's federal administrative system (e.g. Federal Department, State Department, Municipal Agency). Within the given example, the prior interest of the *Service Provider* stakeholder role taken over by an arbitrary public administrative department is to comply with the OZG regulation, represented by the *Implement OZG* driver motivation element. The *Service Provider* stakeholder element is then associated with the *Provide Service* goal motivation element, which is positively influenced by the *OZG Service* outcome element and directly realized by the *Service Provision* business process element carried out by the *Service Provider* business role. Additionally, the *Provide Service* goal element is positively influenced by the *Platform Interface* outcome element, which gets realized by the *OZG Constraint* motivation element associated to the *Department Requirement* motivation element, which represents requirements within the administrative context where the service provision takes place.

Lastly, among the most relevant stakeholder of the FIT-Connect is the *Service Consumer* stakeholder role, in the given example taken over by the *Civil Entity* business role element, which represents any social actor (e.g. citizen or social organization) willing to use administrative services provided on the FIT-Connect platform. The *Service Consumer* stakeholder is driven by the interest to apply for an administrative service, as indicated by the *Apply for Service* driver motivation element. Moreover, the *Service Consumer* stakeholder role element is associated with the *Use Service* goal motivation element, illustrating the stakeholder's prior goal when utilizing the platform in the role of a *Service Consumer*. The *Use Service* goal element is positively influenced by the *Service Requirement* motivation element and the *User Data* outcome element, representing the necessary inputs and service-specific requirements for the *Use Service* goal to be achieved. Also, the *Platform Interface* outcome element positively affects the *Use Service* goal, representing the significance of FIT-Connects interfaces controlling access and service utilization.

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To conclude, after introducing the FIT-Connect platform architecture and its interface architecture, this section addressed the motivational perspectives of the platform's essential stakeholders, illustrating the intentions which impact the structure and behavior of the FIT-Connect platform owner, service developers, service providers and service consumers. In order to achieve this representation, the motivational extension of the ArchiMate notation was introduced and applied to a motivation model. In the following section, both the ArchiMate core elements (namely business- and application layers) and the motivation elements will be further integrated into more detailed stakeholder-specific models. This will support the aim of specifically illustrating each stakeholder's view on the FIT-Connect platform, representing their business- and application structures, as well as their motivation dimensions impacting their behaviors and thus their interactions with the platform architecture.

6.4 Stakeholder Views

The present section introduces a selection of four different stakeholder-specific views on the FIT-Connect platform architecture, considering not only the stakeholders' structural and behavioral scope for actions, but also their motivational dimensions. In order to do so, the previously elaborated fractions of the platform architecture and motivation model will be integrated and further specified into more detailed views for the stakeholder roles of the *Platform Owner, Service Developer, Service Provider* and *Service Consumer* on the FIT-Connect platform. This step is intended to generate a more expressive representation of how different stakeholders organize their behavior and interactions on the platform architecture. Additionally, the views are intended to provide an idea of the stakeholders' individual strategic goals, requirements and constraints, which have an impact on their interaction with the platform architecture. Through the contribution of the stakeholder views, designers of the FIT-Connect platform architecture will be allowed to more efficiently address the needs of the platform's various stakeholders and therefore to enhance the overall ability of the FIT-Connect platform to achieve its intended results. In what follows, models of the four stakeholder views of *Platform Owner, Service Developer, Service Provider* and *Service*

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Consumer will be presented and their construction will be deduced. Please note that the views do not claim to provide a complete and fully error-free picture of the stakeholders' structure, behavior and intentions with regard to their interactions on the FIT-Connect platform. The following models rather represent preliminary draft versions of a small number of FIT-Connect stakeholder views, while additional stakeholder views are likely to be iterated and the following models might be further specified and/or changed within the ongoing development process of the platform architecture. The following models are therefore explicitly to be considered as prototypical contributions, which are intended to be subject of cautious evaluations and further development.

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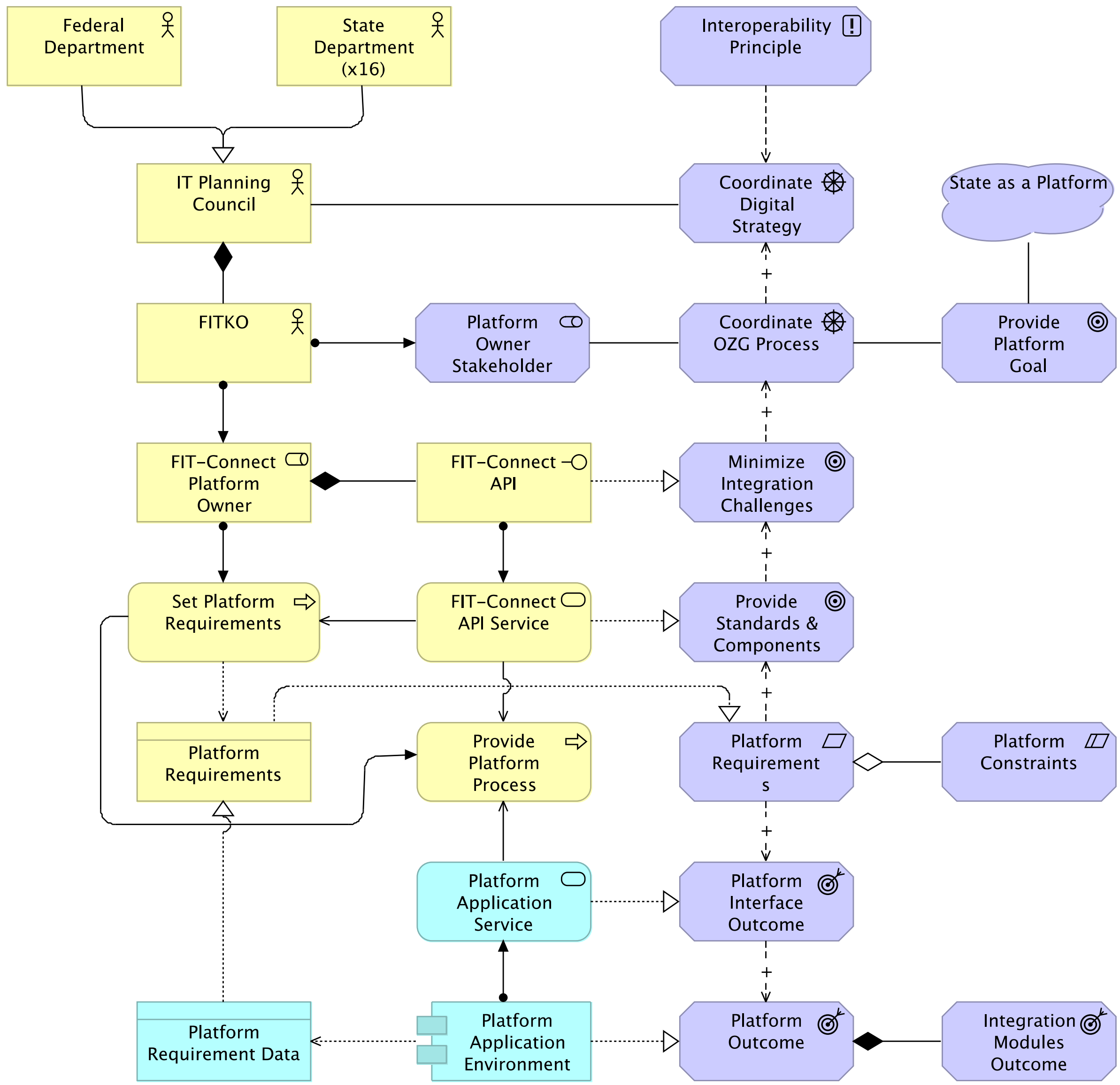

Figure 6: Platform Owner Stakeholder View

The figure above represents the stakeholder view from the perspective of the *Platform Owner*, which in case of the FIT-Connect architecture is FITKO as the executive organization administrating the platform on behalf of the IT Planning Council, which is comprised of representatives from the Federal Government and the 16 States across Germany. This constellation has been modelled through the specialization relations of the *Federal Department* and the *State Department (x16)* business role elements, which specialize to the *IT Planning Council* business role element. The *FITKO* business role element then is

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composed of the *IT Planning Council* business role. FITKO then is assigned to the business role of the *FIT-Connect Platform Owner*, which primary responsibility is to govern the platform architecture. This function is expressed through the *Set Platform Requirements* business process, to which the platform owner role is assigned and which triggers the *Provide Platform* business process. Also, the *Set Platform Requirements* business process accesses the *Platform Requirements* business object element, which realizes the *Platform Requirements* requirement motivation element and itself is realized by the *Platform Requirement Data* object application element. The *Platform Requirements* motivation object aggregates the *Platform Constraints* motivation element. The aggregation relation was chosen in order to express that the platform constraints may be incorporated in the platform requirements, but at the same time are also able to exist as a standalone component. Therefore, since no existence dependency between the constraints- and the requirements motivation element is given, the aggregation relation was selected.

Regarding the motivation dimension of the model, the FITKO business role element is assigned to the *Platform Owner* Stakeholder motivation element, which then is associated with the *Coordinate OZG Process* driver element. This driver element is associated with the *Provide Platform Goal* motivation element, which is associated with the meaning element *State as a Platform*. This construction is intended to express the overall motivation emerging from the *Platform Owner Stakeholder* role motivation element. The *Coordinate OZG Process* driver element positively influences the *Coordinate Digital Strategy* driver element, which is associated with the *IT Planning Council* business role and influenced by the *Interoperability Principle* element. The *FIT-Connect API* business interface element transitively serves both business processes included in the model through the assigned *FIT-Connect API Service* element. This constellation of interface and service business elements additionally realizes two motivation goal elements, namely *Minimize Integration Challenges* and *Provide Standards and Components*. These goals are positively impacted by the *Platform Requirements* motivation element, as indicated by the influence relation.

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The *Platform Requirements* motivation element also positively impacts the *Platform Interface Outcome* motivation element, which is realized by the *Platform Application Service* on the application layer of the model, serving the *Provide Platform Process* business element. The *Platform Outcome* motivation element is positively impacted by the *Platform Interface Outcome* motivation element and is composed of the *Integration Modules Outcome* motivation element, which indicates an existence dependency between both elements. Lastly, the *Platform Interface Outcome* element is realized by the *Platform Application Component* element on the application layer, being assigned to the *Platform Application Service* element. To summarize, the previous model represents the platform ownership view of FIT-Connect, expressing its business- and application structure and behavior in connection with the motivation dimension, including drivers, goals, outcomes, requirements and constraints. In what follows, the *Service Developer* stakeholder view will be presented and further examined.

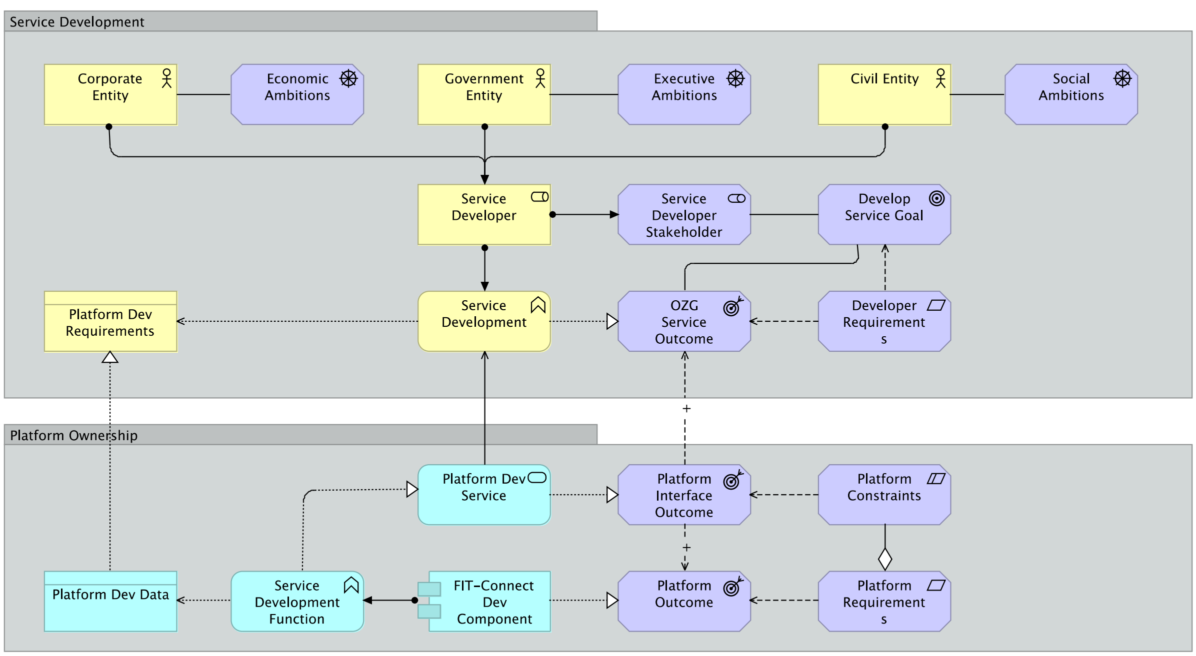

Figure 7: Service Developer Stakeholder View

The figure above presents the *Service Development* stakeholder view, which can be taken from any entity assigned to the *Service Developer* business- and stakeholder role element.

Please note the two different grouping elements *Service* Development and *Platform* Ownership: this illustrates the interaction between these two dimensions, which is required for the service development procedures to be enabled, as essential components on the application layer of the FIT-Connect platform are provided by the *Platform* Owner, as it is in the nature of the platform concept.

As elaborated earlier, it lies in the nature of the FIT-Connect concept that various different actors may optionally be entitled to the *Service Developer* role, since this promotes the platform approach of leveraging resources such as competence and development efforts through work distribution. Consequently, different sorts of business actors and their corresponding motivational drivers have been modelled into the *Service Developer* stakeholder view model. This includes the *Corporate Entity* business actor element associated with the *Economic Ambitions* driver motivation element, representing any sort of private organization assigned to the *Service Developer* role. Alternatively, an entity as part of any public administration in Germany's federal system can take over the *Service Developer* role, as indicated by the *Government Entity* business actor element associated with the *Executive Ambitions* driver element. The following semantics resulting from the *Service Developer* business role element assigned to the *Service Developer Stakeholder* role, apply for any business actor taking over the role of a service developer on the FIT-Connect platform architecture. The *Service Developer Stakeholder* motivation role is then associated with the *Develop Service Goal* motivation element, as this expresses the prior intention of service developers on the platform. The *Service Developer* business role is assigned to the *Develop Service* business function, realizing the *OZG Service Outcome* element. In terms of syntax, the business function element was chosen for the *Service Developer* behavior, as the *Develop Service* activity is of general nature and could be applied to various specific development activities. If this was not the case, a business process element could have been utilized instead.

The *Service Development* business function however, accesses the *Platform Dev Requirements* object which is realized on the application layer of the model in addition to itself realizing the *OZG Service Outcome* element, which is influenced by the *Developer Requirements* motivation element. The *Developer Requirement* motivation element also influences the *Develop Service Goal* and represents any sort of enterprise-internal requirements that might have an impact on the service developer's motivations and goals. While the *Service Development* business function indeed may produce outcomes for the application layer of the FIT-Connect platform (such as OZG Services depending on corresponding application support), the service development procedure itself relies on application support provided by the *Platform Owner*. In order to illustrate this important circumstance, the application support for the service development architecture is grouped within the *Platform Ownership* domain. This construction expresses how the platform owner hosts the application support for service developers, providing them with necessary requirements, constraints and components for their individual purposes.

The application support for the *Service Developer* stakeholder view is structured as following. The *FIT-Connect Dev Component* is assigned to the *Service Development Function* application element, which serves the *Platform Dev Data* object and realizes the *Platform Dev Service* application element, serving the *Service Development* business function. Lastly, the application service and its related application component realize the two outcome motivation elements *Platform Interface Outcome* and *Platform Outcome*, which are related to each other by a positively noted influence relationship. Again, the relationship between the *Platform Requirements* motivation element and the *Platform Constraints* element has been modelled as an aggregation, since the constraints belong to the platform requirements while at the same time maintaining their independence. Both elements exercise influence on the application logics of the *Service Developer* stakeholder view.

To summarize, the previous architectural model represented the *Service Developer* stakeholder view of the FIT-Connect platform, which is an integral dimension of the platform ecosystem. The central business- and application structures and behaviors have been expressed within the model. Also, the motivational modelling elements further specified and illustrated the intentional dimension of the stakeholder view by providing explicit information about drivers, goals, outcomes, requirements and constraints impacting the service development architecture of the FIT-Connect platform.

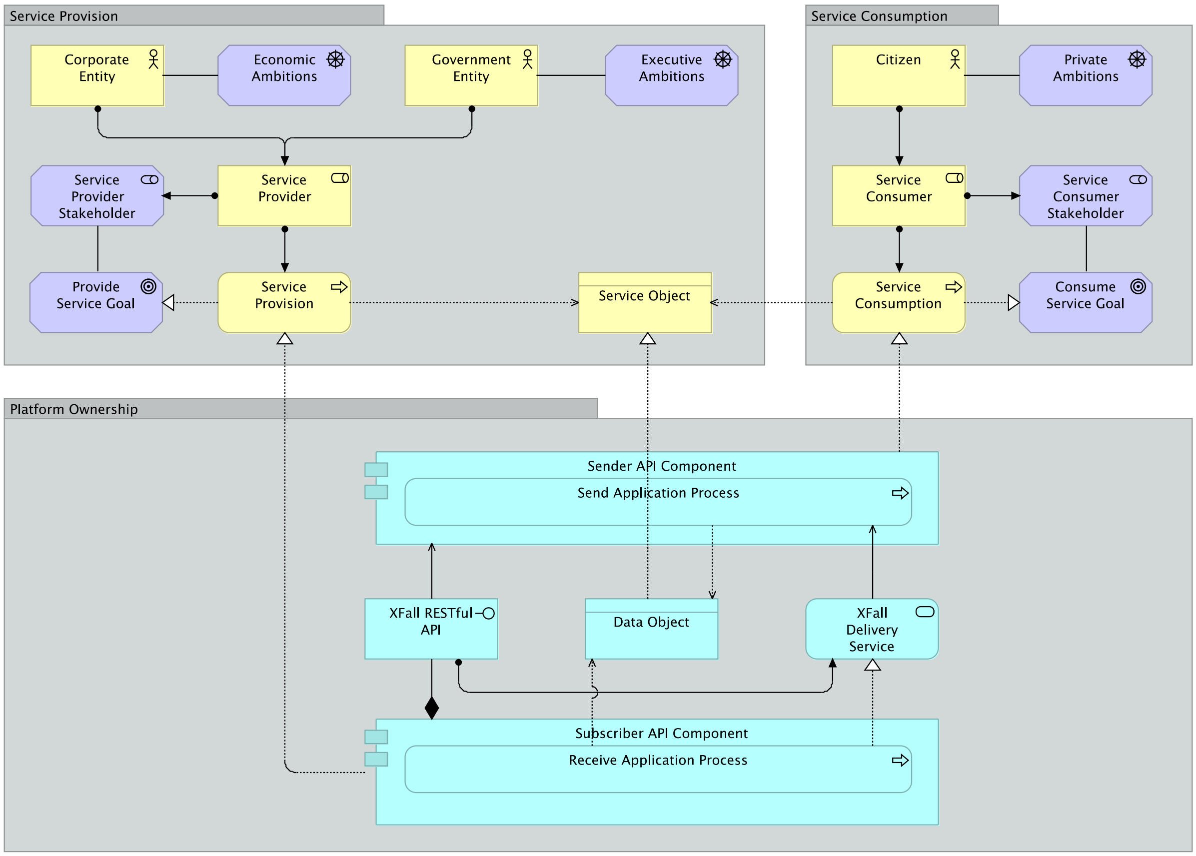

Figure 8: Service Provider and Consumer Stakeholder View

The figure presented above combines the perspectives of the *Service Provider* stakeholder role and the *Service Consumer* stakeholder role in one model. This choice of representation was taken with regard to the FIT-Connect concept, where the business- and application architecture of both stakeholders' procedures are inherently linked with each other. This link is expressed through the *Platform Ownership* grouping element in the model, which comprises the application support elements for the business layer representing the *Service Provision* and *Service Consumption* procedures on the FIT-Connect platform architecture. The *Service Provision* grouping element, which is located on the upper left of the model, displays two business actors *Corporate Entity* and *Government Entity*, which both are assigned to the *Service Provider* business role. As explained previously, also a civil entity could be assigned to the business role of the *Service Provider*, just as a corporate entity could take over the business role of a *Service Consumer*. Nevertheless, in the given model a scenario assumed to occur in most cases was selected for the purpose of illustration. The *Civil Entity* business actor element therefore is located solely in the *Service Consumption* grouping element and assigned to the *Service Consumer* business role element.

Similar to the *Service* Developer stakeholder view, each business actor in the service provision- / service consumption view is associated with their respective driver elements, illustrating their overall motivations to engage with the platform architecture. The *Service Provider* business role then is assigned to the *Service Provider Stakeholder* motivation role, while the *Service Consumer* business role is assigned to the *Service Consumer Stakeholder* motivation role. The stakeholder motivation roles are associated with their respective motivational goal elements *Provide Service Goal* and *Consume Service Goal*, while the business role elements *Service Provider* and *Service Consumer* are assigned to their corresponding business process elements *Service Provision* and *Service Consumption*. The business process elements realize the goal motivation elements and access the *Service Object* business element, which in most cases might be comprised of an application file and attachments.

Following the concept of platform architecture, the application support for service provision and service consumption is provided by the *Platform Owner* of the FIT-Connect architecture, as indicated by the *Platform Ownership* grouping element. The presented application elements fulfill the interface function of the FIT-Connect platform, as is was specified within the section addressing the platform’s interface design previously within this thesis. Please note that in addition to communicating through the platform owner’s interface applications, both service providers and service consumers may be incentivized or even obliged to apply their individual application architectures in order to support their business procedures. These individual application architectures are not included in the model presented above, as this section solely addresses the platform dimension of service provision and service consumption. Also, while stakeholder-specific application support is considered likely to be a

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necessity for the service provision and service consumption view to function, such architectural constructions as part of the platform ecosystem will be highly dependent on the respective stakeholders applying them and therefore cannot be generalized in order to be presented within this thesis. The given model in this sense may serve as a reference for how to design service provision and service consumption on the platform architecture of FIT-Connect, which may depend on further extension, adaption or specifications in the further development process or within the specific application for individual stakeholders.

Representing the application support provided by the platform owner, the model above displays the interface design of the FIT-Connect platform architecture as elaborated previously within this thesis. Applied to the *Service Provider* and *Service Consumer* stakeholder view, the interface application elements regulate the interaction between the *Service Provider* and the *Service Consumer* procedures, as well as their interaction with the *Platform Owner* stakeholder through the application layer of the platform architecture. In the presented model, the platform interface is comprised of two application components, *Sender API Component* and *Receiver API Component*. Both application components are assigned to respective application process elements, which serve the *Data Object* application element realizing the *Service Object* business element to be accessed by the stakeholder business processes. Each of the stakeholder business processes *Service Provision* and *Service Consumption* is realized by the corresponding application component of the *XFall RESTful API* FIT-Connect interface, which is assigned to the *XFall Delivery Service* application element connecting the application processes. As explained previously, each different business role *Service Provider* and *Service Consumer* will rely on individual application support in order to exercise their procedures, which would be indicated by respective application services serving their business roles. However, the individual application support for specific stakeholder has not been included in the model for generalization purposes.

Lastly, also the associated motivation elements such as drivers and goals are intended to be extended and further specified addressing individual stakeholder needs. To summarize, the model above represented the *Service Provider* and *Service Consumer* stakeholder views on the platform architecture of FIT-Connect. The model presented the business procedures and motivation dimensions of both stakeholders providing and consuming services on the platform architecture. The application support provided by the platform owner stakeholder was included in the model and the application layer was mapped to the model's business layer, illustrating how different interactions among stakeholders can be realized.

To summarize, this section presented the overall research contribution of this thesis by extensively elaborating on enterprise architectural perspectives on the FIT-Connect platform, its interface construction and on stakeholder-specific views and their means of interaction with each other and the platform. The designed EA models are intended to substantially contribute to a clarified understanding of how the FIT-Connect platform and its ecosystem are structured, how the platform interfaces exercise their regulating functions through the platform ownership on the stakeholder behavior on the platform architecture contributing to the platform ecosystem. Though the design contribution of this thesis built on tangible concepts in collaboration with FITKO as the coordinating entity with regards to Germany's federal digitalization strategy including the administrative IT architecture, many aspects such as stakeholder-specific configurations and structural arrangements are to date dependent on future development decisions. For this reason, the EA models proposed within this thesis took a generalizing design approach, in order to produce universally applicable EA structures, processes and constructs, which can be specified individually according to more distinct contexts and requirements.

By this matter, the empirical contribution of this thesis provides insights addressing how the FIT-Connect platform supports the digitalization initiatives of German public administrations on the federal- and the state level, while the municipal administrations are subordinated to the state administrations. The local administrative entities therefore will be integrated with the FIT-Connect platform in a transitive manner through their link with the respective state authorities. The provided EA models present how the different public administrative entities can strengthen their digitalization efforts by collaborative means and how the platform ecosystem can accelerate the OZG implementation process by enabling external

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stakeholders to develop and to provide services and applications for the administration and citizens. It was expressed that the proposed EA models are not claimed to be entirely complete or irrevocably accurate, but rather are intended to be considered as a general reference for universal structures, procedures and behaviors that may occur within the platform ecosystem. The developed referential architectures may rely on further development and individual specification, according to future design decisions.

Nevertheless, the proposed EA contributions are designed to cover the FIT-Connect platform concept's essential functions and they may provide basic value to a broad variety of OZG implementation scenarios through their abstracted construction. Following the empirical method of Design Science previously introduced and subsequently applied to the research procedures, the developed artifacts will be structurally demonstrated and evaluated in the following section to assess their capableness and usefulness for the earlier identified problem- and objective definition. This last methodological step will be carefully examined and followed by a critical reflection of the research process and a concluding section summarizing the thesis' procedures and contributions based on all previous elaborations.

7 Evaluation

After the design of the developed artifacts has been carried out according to the DSRM, this section is concerned with an assessment of the proposed solution approaches. In order to conduct an evaluation procedure which is compliant with the applied methodological framework of Design Science, the developed architectural models and their functioning will be presented and demonstrated to one specialist as part of the FITKO agency in the department of federal IT architecture (FAM) [Föderales IT-Architekturmanagement], which then will provide an assessment of the proposed artifacts and their capableness to address the identified problem and to contribute to the defined objectives of this thesis. The evaluation procedure of this thesis is intended to provide an objective and independent assessment of the research contribution's ability to produce the desired results and intended outcomes. Criteria in order to achieve an expressive assessment of the developed artifacts

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include their efficacy, applicability and usefulness for practice, completeness, internal consistency, level of detail and their suitability for real world phenomena of the field of this research.

First, the selected problem will be elaborated and formulated, as it has been carried out within the previous sections of this work. Thus, the selected problem and defined objectives will be recapitulated and their meaningfulness and importance for practice will be motivated based on the elaborations made within the 'Problem Identification' and 'Objective Definition' sections of this thesis. The design artifacts will be demonstrated as approaches that embody the solution to the identified business problem and that work in the context of the organizational setting. The artifact design has been specified according to the previously stated design objectives. The designed artifacts are intended to facilitate a solution to the defined problem. Practically, the artifact design will be specified in the form of architectural models. By doing so, additional instances of the business problem will be derived. The models will represent an analytical example by providing relevant input information and constraints. This is carried out to demonstrate how the artifacts are expected to work given the specified information and constraints. This may trigger further design revisions and iterations.

Subsequently, a questionnaire will be generated as a catalog of questions to be raised towards the selected specialists within one discursive interview. The questionnaire will be derived from the mentioned evaluation criteria and be represented subsequently within this section. Selected statements produced by the interviewee will be translated from German to English language and partially cited within this section of the thesis. These assessments will serve as a basis for a further iteration of the design creation of the IT architectures and a subsequent critical reflection of the research procedure, its contributions and its limitations, which will be provided on the following section of this thesis. Lastly, the evaluation of the proposed solution approaches will also allow to draw closing conclusions suggested by this thesis and its attempt to contribute to a valuable solution for its domain.

As discussed within previous sections of this thesis introducing the empirical methodology of this thesis, the high degree of heterogeneity among Germany's federally organized administrative system and a lack of universal standards are dominant factors affecting the situation of public digitalization in Germany. These discrepancies span over various dimensions, such as varying organizational structures and procedures among administrations, but also heterogeneously applied IT systems and network constructs. This high degree of technical and organizational heterogeneity was identified as the most significant problem impeding the OZG implementation process. Therefore, it was postulated as an objective within this thesis, that a solution should be able to manage differing IT systems and deviating organizational structures, integrating heterogeneous information chains and administrative procedures by making them interoperable. At the same time, another highly relevant feature for a developed solution was defined, which is the facilitation of a high degree of autonomy among network participants. While maintaining a high degree of autonomy may appear as a contradicting feature compared to the previously stated need for more standardization at the first sight, these features in fact complement each other. Since in Germany, the public administrations in particular, but also the country's economy are highly decentralized and heterogeneous, the possibility of independent and heterogeneously organized network participants must be given. This was defined as an objective in order to save high expenses which would be caused by too extensive reconstructions, but also in order to exploit as many potentials of participants as possible and not to undesirably exclude participants that otherwise would have provided valuable contributions to the network. The defined objectives therefore must serve standardizing purposes in order to create interoperability among heterogeneous entities and systems, but at the same time must refrain from unnecessary restrictions and allow a maximal amount of autonomy for various participants to exploit their potentials.

Given this problem identification and consequently defined objectives, the FIT-Connect platform was conceptualized by the FITKO agency and then a first blueprint of its platform architecture was designed as a core contribution of this thesis. The evaluation questionnaire

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created in order to provide a brief assessment of the developed artifacts contains the following questions: To what degree do the proposed models represent the intended architecture of the FIT-Connect platform? To what degree fulfill the provided models the intended purposes and functions of the architecture? How complete are the proposed models? How precise do the proposed models represent the functioning of the FIT-Connect platform architecture based on the FITKO concept? To which degree do the provided models contribute value to the FIT-Connect project? Which limitations do the provided models exhibit? How could the provided models be improved? Are there significant aspects of the FIT-Connect platform which were not considered in the proposed models? Are there aspects represented within the proposed models which are irrelevant?

Following the evaluation-specific implications of DS and the DSRM, the expert feedback extrapolated from the discursive interview has been incorporated within an additional iterative design step. The proposed models have been adjusted according to the comments and stimulations posed within the discursive evaluation interview. The iterative adjustments will be presented within the following models and elaborated within more detailed descriptions, explaining the measures that were taken in order to suit the models into their organizational practice-oriented context.

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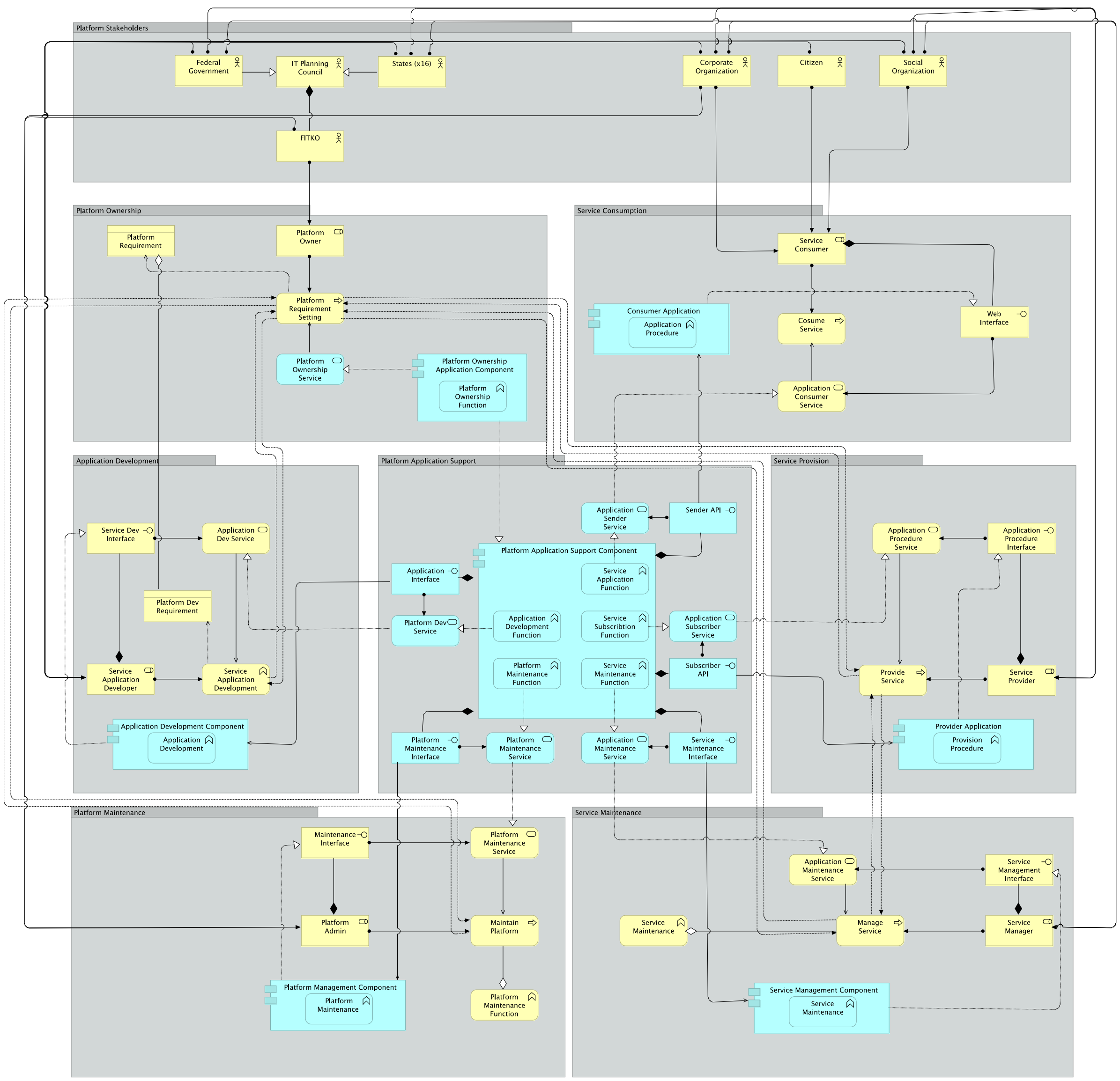

Figure 9 Iterated Platform Architecture and FIT-Connect Ecosystem

The figure presented above displays the adjusted design of the FIT-Connect platform architecture and ecosystem. Most significantly, the application support has been added to the different dimensions of the FIT-Connect platform ecosystem. This major modification can be ascribed to ambiguities expressed within the evaluation interview regarding the interface communication and its representation within the model. In order to represent the interface governance and functionalities of the platform elaborated previously within this thesis, it was identified as relevant within the evaluation interview to explicitly represent the application support for each stakeholder and platform dimension within the platform architecture. This assessment is based on the interface design of the FIT-Connect architecture, which concentrates all communication and exchange information on the interaction of application components of the stakeholders. For this reason, it was postulated as highly relevant within the evaluation phase, to include the application support of platform users into the model of the FIT-Connect ecosystem, instead of restricting the interactions among stakeholders to their business layers. In order to achieve the goal of precisely and correctly representing the platform governance and ownership through its interface design, the application support of the platform was extended significantly, as it can be perceived as part of the *Platform Application Support Component* grouping element. In the iterated model of the platform architecture and ecosystem, the platform application support is positioned at the center of the model and contains an application component element comprising various application functions, which realize respective application services.

The application service realizes the business services of the functional platform dimensions represented within the other grouping elements of the model, while the realized business services then provide a basis for the actual business processes and business functions performed by the stakeholders. Additionally, as part of the *Platform Application Support Component*, each application service possesses one specific application interface assigned to it. The application interface elements are composed of the *Platform Application Support Component*. These semantics apply to every functional platform dimensions modelled in the platform architecture and FIT-Connect ecosystem: *Service Consumption, Service Provision, Service Maintenance, Platform Maintenance, Application Development*. Through these constructs, the interface governance is represented within the platform architecture. A special role is taken by the *Platform Ownership* dimension, as its application component is not realized by the *Platform Application Support Component*, but it realizes the application support of the FIT-Connect platform. By this means, the platform ownership is intended to be properly expressed within the proposed model of the FIT-Connect platform architecture and ecosystem.

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While the governance and interaction among different stakeholder on the platform technically is performed through the application layer as it was described and modelled previously in the iterated model of the platform architecture and ecosystem, this exchange of information realizing the potential of the ecosystem has been additionally illustrated through the reciprocal flow relations among the behavioral elements of the business layer. This applies in particular to the *Set Platform Requirement* business process element within the *Platform Ownership* dimension, as the requirements setting represents the core element of the FIT-Connect platform governance impacting all behaviors performed by other stakeholders of the ecosystem. While the platform requirements and –constraints technically are enforced through the interface governance and the *Platform Application Support Component* realized by the *Platform Owner* through its *Platform Ownership Application Component*, the flow relations between the business behavior elements serve as an additional illustration of this correlation on the business layer of the model, since the application governance does have significant impact on the business sphere of the platform ecosystem.

Another major adjustment derived from the discursive evaluation interview is the separate modelling of the *Platform Stakeholders* grouping element, representing the FIT-Connect stakeholder dimension. This decision has been taken, in order to model the stakeholder business actors only once, but at the same time assign them to all potential business roles they may feel incentivized to take over within the FIT-Connect ecosystem. In this regard, the assignment relations between the business actor elements and the business role elements have been explicitly modelled as part of the platform architecture and ecosystem. Moreover, the infrastructure layer of the FIT-Connect platform architecture has been identified as not a priority at the current development stage, which resulted in a removal of the technology elements of the model. Same applies to the passive structure elements such as data objects and business objects: while the exchange of information and data is a universal and permanent occurrence within the FIT-Connect platform ecosystem, it was attested to result in trivialities to model data flows as part of the overall platform architecture. This design decision also contributes to the clarity and comprehensibility of the model.

Besides the supplements and amendments elaborated previously, the proposed model of the FIT-Connect platform architecture and ecosystem was assessed as broadly correct and complete during the evaluation interview. Generally, the proposed model of the platform architecture and ecosystem was evaluated as value-contributing to the FIT-Connect platform project. Nevertheless, the iterated model of the platform architecture must be assessed through another iterative evaluation phase and therefore cannot not guarantee absolute correctness and completeness. To summarize, the platform architecture was slightly refined and adjusted in response to remarks stated within the evaluation procedure of this thesis. Most significant refinements address the interface governance of the platform through its application interfaces. An extensive description of how the API Design of the FIT-Connect platform was adjusted in consequence of the evaluation interview can be found in what follows.

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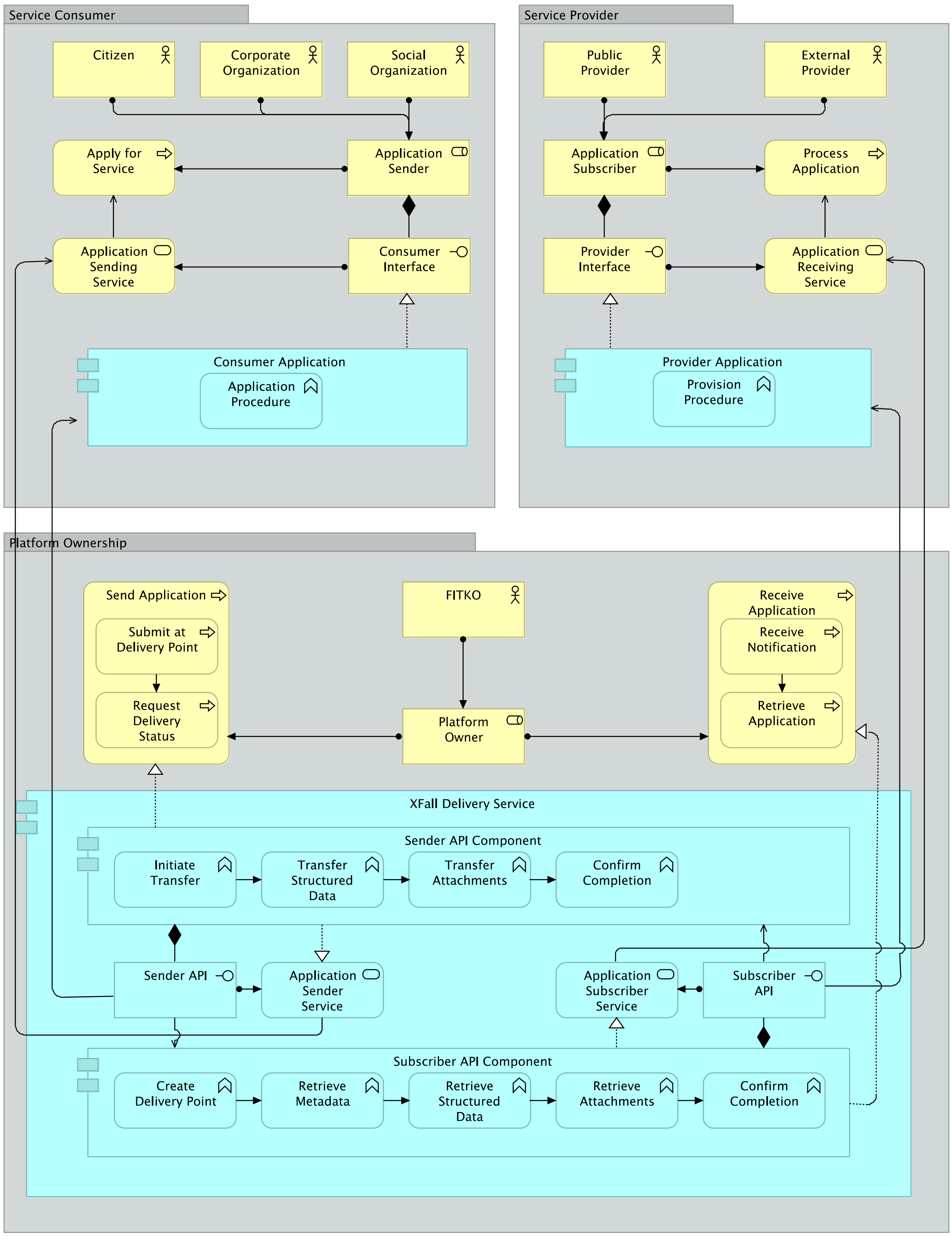

Figure 10: Iterated Platform Interface Architecture

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The figure presented above illustrates the iterated model of the platform interface design derived from remarks extrapolated from the discursive evaluation interview. The stakeholder dimension, in the given model *Service Consumer* and *Service Provider*, now base their business structure on individual application components, which support their business processes. The business processes are served by respective business services, which are connected through serving relations to the application layer of the platform ownership dimension, containing the application interface construction of the platform ecosystem. During the evaluation procedure of this thesis, it was assessed as relevant to illustrate the interaction between the application structures of platform owner and platform users into more detail. For this reason, the *XFall Delivery Service* application component element was modelled to contain the two application components *Sender API Component* and *Subscriber API Component.*

Furthermore, each of the subordinated application components realize their individual application services *Application Sender Service* and *Application Subscriber Service*, which then serve business services serving the business processes of the stakeholders. Both application components of the *XFall Delivery Service* element aggregate one specific application interface which are assigned to the application services and serve the application components of the stakeholders. As designed in the model, there is no direct interaction given between the various business structures of the platform stakeholders. All interactions are performed between the application elements of the platform dimensions. The proprietary aspects of the interface communication are handled within the business layer of the *Platform Ownership* dimension, while the stakeholder structures perform their business processes independently and receive application support through the *XFall Delivery Service* application component where necessary.

Through this modified iterated structure, this thesis attempts to correctly illustrate the interface design of the FIT-Connect platform architecture and to illustrate the governance functionalities through the FIT-Connect application interfaces. Again, the proposed iteration

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must be assessed through further evaluation procedures, which are not in the scope of the given research. Therefore, the proposed iteration of the platform interface design cannot be considered as universally correct or complete, which supports the conception of EAM as a constantly ongoing procedure, iteratively striving for improvements. In what follows, the last architecture iteration of the motivational model will be presented and the executed adjustments will be illustrated and derived in detail from the evaluation interview.

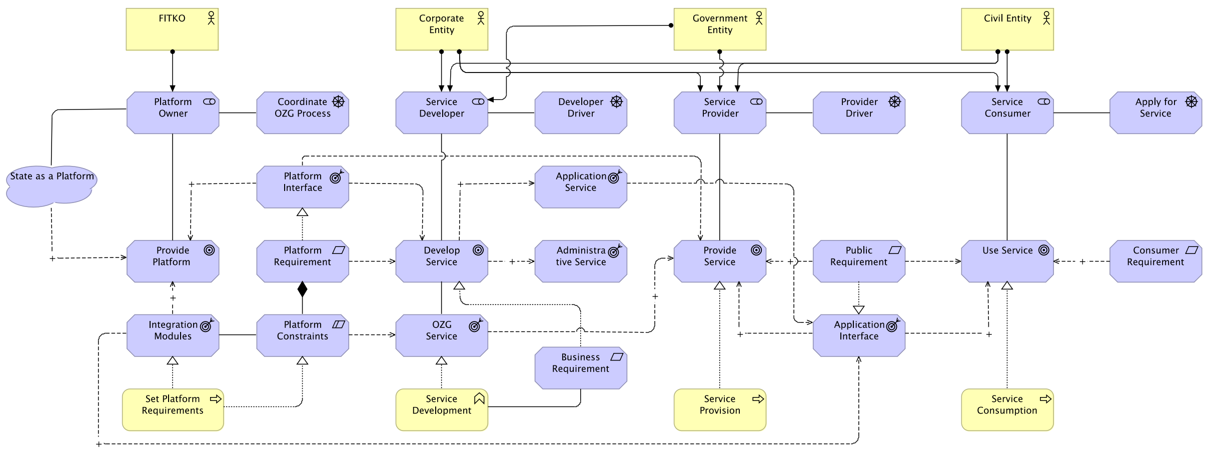

Figure 11: Iterated Motivation Model

The figure above represents the iteration of the platform motivational model, incorporating adjustments made in response to the evaluation procedure. The previous design decision not to relate the assignments of each business actor role to its respective potential stakeholder roles for the purpose of conciseness, caused uncertainties during the discursive interview. For this reason, now each business actor element was explicitly related to all potential stakeholder roles it may feel incentivized to take over. This modification is illustrated by the various assignment relations on the top level of the motivation model.

Additionally, slight adjustments were made to the motivation elements, mainly in order to create motivation scenarios applicable to a broader variety of stakeholders. In order to achieve this universal applicability, the motivation elements were further generalized. This design decision potentially comes at the cost of the model's expressive capabilities, as motivation elements exceeding an certain degree of generalization may be not specific

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enough to express more than a trivial motivation of stakeholders. Within the discursive evaluation, the motivation model was assessed as broadly comprehensive and correct, but the evaluation procedure also exhibited the rather general nature of the motivation model, not being able to capture specific particular implementation scenarios. For this reason, the motivation model may be suitable to illustrate general and universally applicable interests and motivational factors of stakeholders. More precise and expressive motivation models however must be based on particular and unambiguous cases, which explicitly clarify who certain stakeholders represent and what contextual factors influence their motivations.

7.1 Critical Reflection

This section is intended to pose a critical reflective review of EAM and particularly the ArchiMate notation as a tool for representation and communication within an enterprise-organizational context. This critical consideration of ArchiMate as a tool having a significant impact on an enterprise’s strategy and practice is grounded on an argument proposed by Kaplan (2011), postulating that the application of technological aids (as which the ArchiMate notation can be considered) not only supports organizational performance but also “constrains expression to certain templates, forces oversimplification, and even edits thoughts” (Kaplan, 2011, p. 320). While the application of EAM and the ArchiMate modelling notation were proposed as powerful tools for the structuring and transformation of organizations through complexity reduction within the previous sections of this thesis, they necessarily also impose their systemic logics within their sphere of activity and thus shape, impact and restrict the organizational behavior and structures of enterprises.

While EAM and ArchiMate serve as effective and supportive tools for the structuring and transforming of organizational and technical structures on the one hand, their capabilities also imply limitations that eventually may not be able to sufficiently meet the contextual requirements of highly complex organizational constructs, such as the German public administrative system and its technological proceedings within the OZG implementation process. Regarding this thesis, these insufficiencies manifested particularly within the tensions between the functionality of complexity reduction and its constrains on the expressive capabilities of the motivation model of the FIT-Connect platform. In the sense of Kaplan (2011), EAM initiatives and its modelling notation therefore should not be considered as "a static piece of technology but rather that it exists as enacted in the organization", actively influencing an enterprise's knowledge production and thus its strategic choice and action under conditions of uncertainty (Kaplan, 2011, p. 343).

Lastly, this section does not intend to conclusively rate EAM as advantageous or disadvantageous initiatives to address the OZG implementation progress within Germany's public administrative context. It rather attempts to outline potential strengths and weaknesses of the approach selected within this thesis, by examining it from diverse perspectives. The empiric contributions of this research therefore may not be received as a sound basis for the practical application of EAM within the OZG implementation process, but rather as an initial rapprochement between the EA discipline and public innovation practices in Germany. Therefore, this thesis may not be capable to provide sound practical value to the goal of immediate implementation of EAM within the OZG context, but potentially may motivate further research addressing more specific and detailed application scenarios, such as concise EA representations of particular OZG services in their respective organizational and technical contexts.

8 Conclusion

This thesis addressed FITKO's platform project as a central coordination component of the OZG implementation process in Germany. After elaborating on contextual public digitalization concepts and initiatives within Germany's decentralized administrative structure, this research motivated Enterprise Architecture Management (EAM) as a suitable approach to support an effective and efficient execution of the OZG regulation. Building on Enterprise Architecture theory, it applied EAM modelling methods and the ArchiMate modelling notation to the FIT-Connect platform concept and designed comprehensive architectural models of the platform's IT architecture. The design process was guided by

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established Design Science literature and empirically conducted through the DSRM procedure, including the iterative sequence of problem identification, objective definition, design development and evaluation of the created artifacts.

First, this thesis argued that EAM potentially can provide a systemic description of an enterprise by aligning organizational and technical perspectives and thereby shapes organizational reality. Subsequently through the application of empirical methods, this research applied the EAM theory to the FIT-Connect platform concept and developed architectural models of the platform architecture, its interface design and relevant stakeholder perspectives of the platform ecosystem. As part of the the last empirical step of the DSRM process sequence, the proposed models were evaluated in collaboration with FITKO’s Architecture Unit [Referat Architekturmanagement], in order to assess their quality in terms of functionality and precision.

Generally, this thesis contributed to a more detailed illustration of the current development process of the FIT-Connect platform in the course of the OZG implementation process in Germany. While the empirical contributions if this research were presented as rather abstracted versions of EA models in order to make them universally applicable and accessible for various stakeholders of the FIT-Connect platform ecosystem, they are intended to serve as a blueprint or orientation for further design initiatives within the development of the platform and its ecosystem. In this sense, the design contributions of this thesis rely on further and more precise adaption procedures, in order to make them applicable and truly functional for an extensive variety of individual use cases.

Lastly, this thesis demonstrated the creative potential of the EAM discipline applied to the sphere of public innovation, integrating knowledge from public administration and information systems as different scientific domains. This pluralistic approach of integrating established concepts from different spheres, allows EAM to operate not only within the narrow borders of one academic discipline, but enables input and output from beyond. Mutually, EAM enabled this research to integrate ideas from different professional perspectives and applied them to contemporary challenges of public digitalization in

Germany. Therefore, this research elaborated and presented its contributions from a pluralistic perspective and enhanced the understanding of the complex correlations within the OZG implementation process through the derivation of interdisciplinary symbiotic grids.

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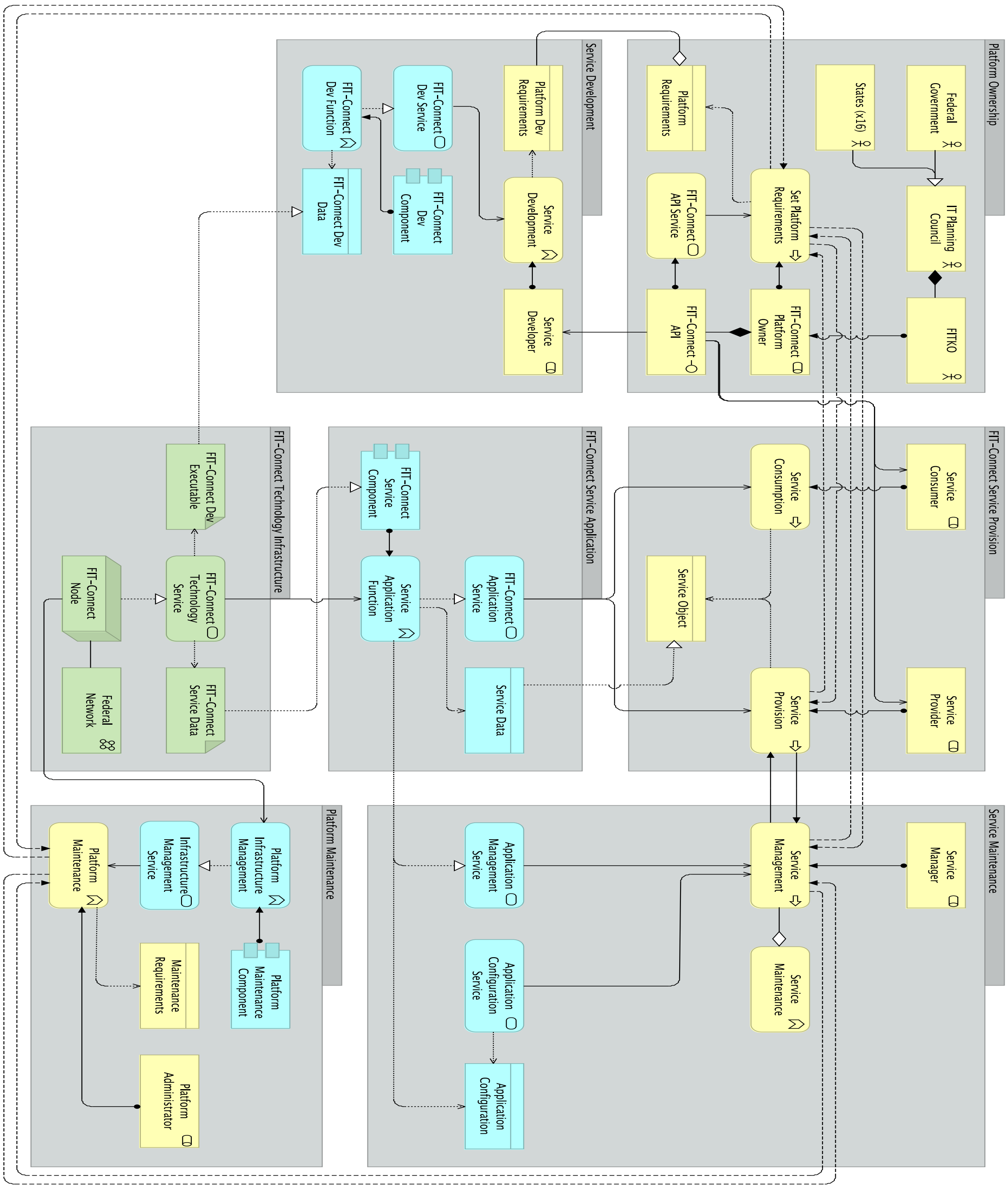
10 Annexes

Annex 1: FIT-Connect Platform Architecture (Figure 3)



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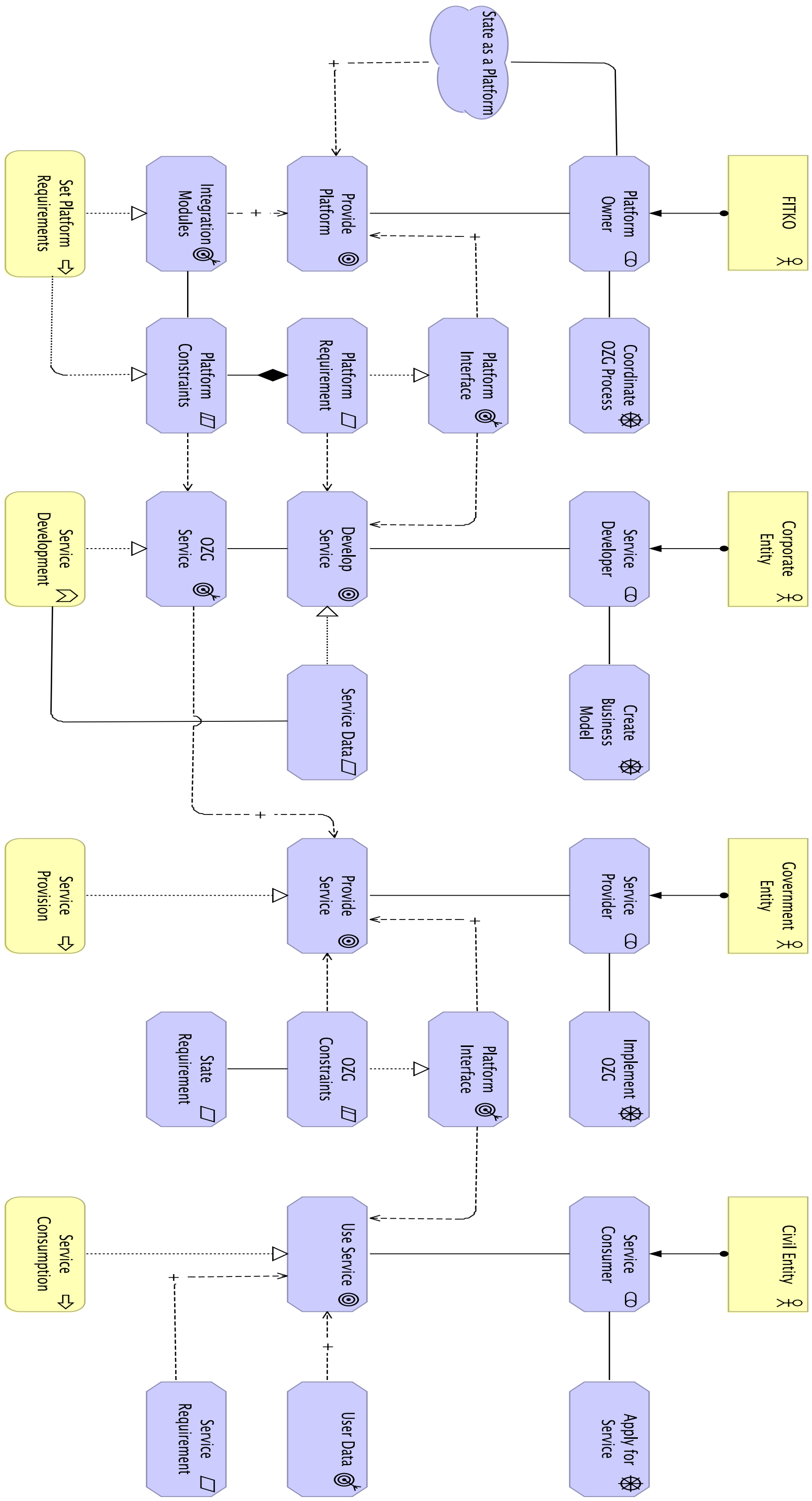
Annex 2: FIT-Connect Motivation Model (Figure 5)



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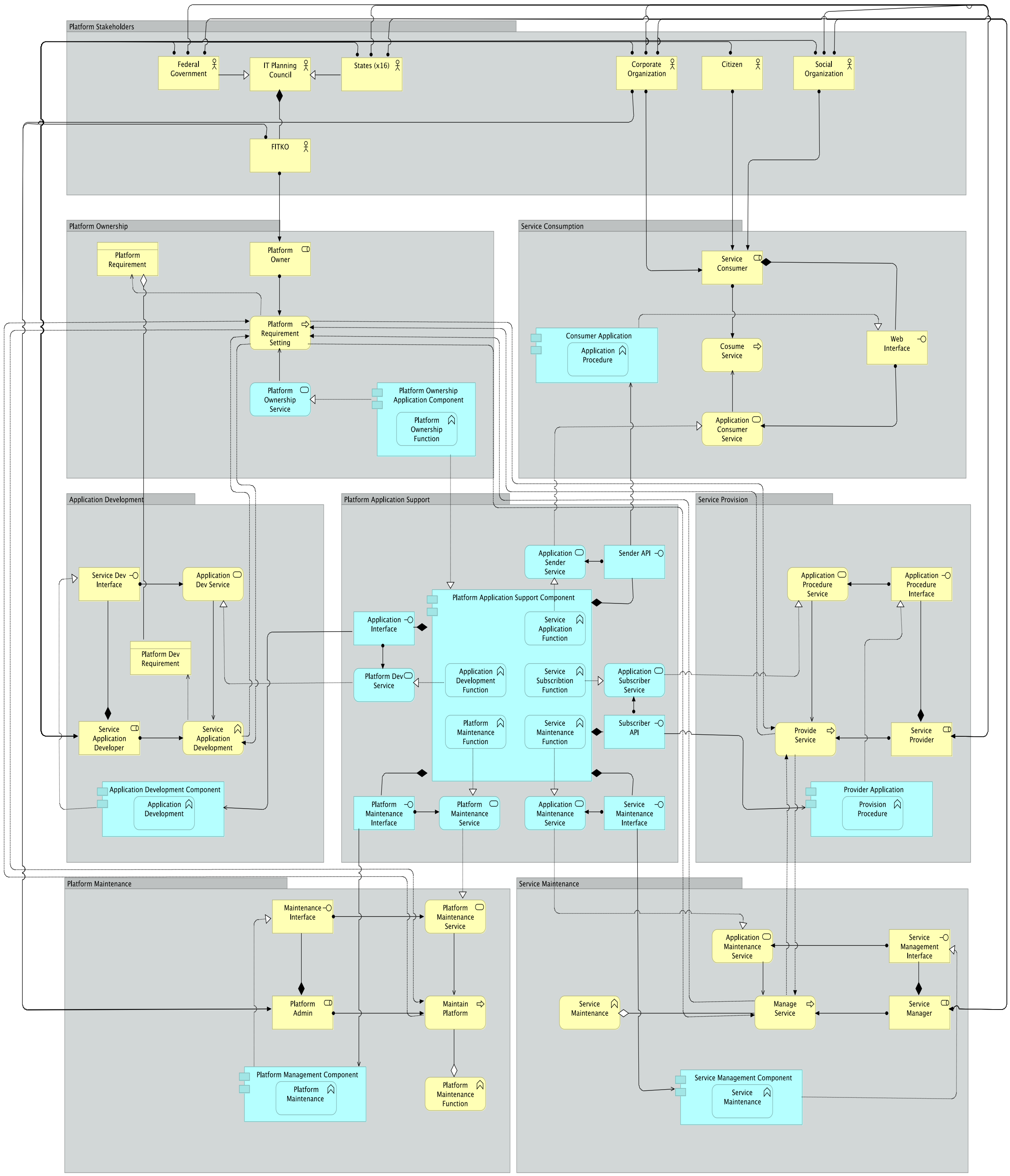
Annex 3: Iterated Platform Architecture and FIT-Connect Ecosystem (Figure 9)



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Annex 4: Iterated Motivation Model (Figure 11)