A Smart Tourism Platform Reference Architecture for Developing Countries

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Abstract

The tourism industry holds significant importance in fostering economic growth and development. In the year 2019, it made a substantial contribution, amounting to 10.4 percent of the global Gross Domestic Product (GDP). However, the tourism industry has experienced significant impacts due to the COVID-19 pandemic, as measures aimed at mitigating the spread of the virus have had direct implications on tourism and travel. Historical records indicate that the tourism sector consistently encounters difficulties from uncertainties and crises, often resulting in prolonged recovery periods. There are several rising initiatives to tackle the problem, including smart technologies. Nevertheless, a concrete and feasible roadmap for realizing smart tourism development is presently absent. Based on the study, there is a correlation between smart tourism and tackling the problem of complexity and uncertainty within the industry. Specifically, developing countries face distinct challenges compared to developed ones because they have lower resources, more precarious social and cultural environments, and are usually more affected by external factors, all of which influence their competitiveness as tourist destinations. Therefore, a twofold approach is proposed to confirm the anticipated advantages this reference architecture could offer to stakeholders. ArchiMate, as a mature modeling language that has gained a reputation in the academic field has been utilized in this research through several viewpoints, such as application usage and marketing business cooperation. Furthermore, LeanIX is a widely known industry expert as a software system to manage the enterprise architecture in daily operations. Therefore, the combination of academic and practical ways of seeing the problem in context brings holistic way to improve smart tourism practices in the field. The solution architecture of both solutions has been presented to the experts. From the design validation session, the average score ranged from 3.8 to 4.5 and the standard deviation was smaller than 1. Finally, from the experts who come from the academic field and smart city practitioners, they generally approved that this reference architecture is able to improve smart tourism practices for developing countries that support tourism competitiveness.

Keywords Reference Architecture, Smart City, Smart Tourism, ArchiMate, LeanIX, Developing Countries

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Chapter 1

Introduction

The tourism industry holds significant importance in fostering economic growth and development. In the year 2019, it made a substantial contribution, amounting to 10.4 percent of the global Gross Domestic Product (GDP) (Council, 2023). However, the tourism industry has experienced significant impacts due to the COVID-19 pandemic, as measures aimed at mitigating the spread of the virus have had direct implications on tourism and travel (Ahmad, Li, Hdia, Bélas, & Hussain, 2023). The enforcement of local and regional COVID-19 lockdowns and international travel constraints has adversely affected both global and domestic hospitality (Hao, Xiao, & Chon, 2020).

Historical records indicate that the tourism sector consistently encounters difficulties from uncertainties and crises, often resulting in prolonged recovery periods (Novelli, Gussing Burgess, Jones, & Ritchie, 2018). There are several rising initiatives to tackle the problem, including smart technologies. The notion of smart tourism destinations primarily emerges from the application of technological advancements and principles of governance (Gretzel & Collier de Mendonça, 2019), which utilize technological infrastructures to establish a digital ecosystem (Baggio & Del Chiappa, 2013). Nevertheless, a concrete and feasible roadmap for realizing smart tourism development is presently absent (Gretzel, 2021).

Enterprise Architecture is a common practice to realize the implementation roadmap. Enterprise Architecture encompasses a unified set of principles, techniques, and frameworks applied in shaping and implementing the organizational framework, operational procedures, information systems, and infrastructure of an enterprise (Lankhorst, 2017). Furthermore, the reference architecture is a simplified representation of components, outlining their primary functions and interactions. It encapsulates the fundamental aspects of current software systems within a specific domain and provides a framework to inform the architectural blueprint of new software systems within that domain. (Garcés et al., 2021). Therefore, the industry has the same baseline to build an enterprise architecture by having the reference architecture. It is supported by the purpose of the reference architecture, which is to serve as a guide for the development, standardization, and evolution of architecture in a particular industry (Cloutier et al., 2009). Moreover, architectures for standardization are more favourable to industry practitioners (Garcés et al., 2021).

Several domains have published reference architectures due to industry, academia, and their collaboration. The findings from the study about reference architectures have shown that the interests of the domains from the industry or the academia are within two domains: transportation and software environments (Garcés et al., 2021). Industry practitioners have been active in making a reference architecture for transportation domains. Meanwhile, academia focuses on software environment domains (Garcés et al., 2021). The current state of the art shows that reference architecture for the tourism industry has yet to be actively researched.

Based on the study, there is a correlation between smart tourism and tackling the problem of complexity and uncertainty within the industry. Specifically, developing countries face distinct challenges compared to developed ones because they have lower resources, more precarious social and cultural environments, and are usually more affected by external factors, all of which influence their competitiveness as tourist destinations. (Roopchund, 2020). However, proposals have been insufficient for a foundational reference architecture specifically tailored to foster smart tourism for developing countries as the foundation to realize a reference architecture that may lead to decreased system diversity as well as lower expenses for maintenance and operation within the environment (Schmidt & Buxmann, 2011). Given this context, this study presents a reference architecture for a smart tourism platform tailored to a developing country.

1.1 Research Objectives

The historical records reveal a pattern in the tourism sector, where it frequently grapples with challenges arising from uncertainties and crises, leading to extended recovery periods (Novelli et al., 2018). Various emerging solutions are being pursued to address this issue, with smart technologies being one of the prominent solutions. The concept of smart tourism destinations primarily arises from integrating technological advancements and governance principles (Gretzel & Collier de Mendonça, 2019). As the cornerstone for establishing a reference architecture, it holds the potential to reduce system variations and cut down on maintenance and operational costs (Schmidt & Buxmann, 2011).

Introduce a reference framework for smart tourism platforms within the context of developing countries.

A twofold approach is proposed to confirm the anticipated advantages this reference architecture could offer stakeholders within the smart tourism ecosystem. A systematic literature review will be conducted to study an initial reference architecture for a smart tourism strategy. This structure will be composed of architectural elements gleaned from pertinent research articles. Secondly, it will be imperative to pinpoint the specific context in which this reference architecture can be further refined, put into practice, and assessed. Subsequently, a concrete enterprise architecture will be devised based on the evolved reference architecture, tailored specifically for the context of developing countries. This comprehensive architecture will encompass the functional requisites for the solution architecture aligned with the reference architecture. This solution architecture will undergo testing with stakeholders in a real project setting to gather feedback and validate the design choices of the reference architecture.

1.2 Research Methodology

1.2.1 Design Science Research Methodology

As this thesis is a part of design science, it revolves around this methodology. Design science involves the systematic procedure of designing and evaluating artifacts within their context. The examined artifacts are created to address a particular problem context, intending to improve specific aspects within that context (Wieringa, 2014). The engineering cycle within design science involves design tasks, which the entire cycle can be seen in Figure 1.1. The design task is divided into three activities: problem investigation, treatment design, and treatment validation.

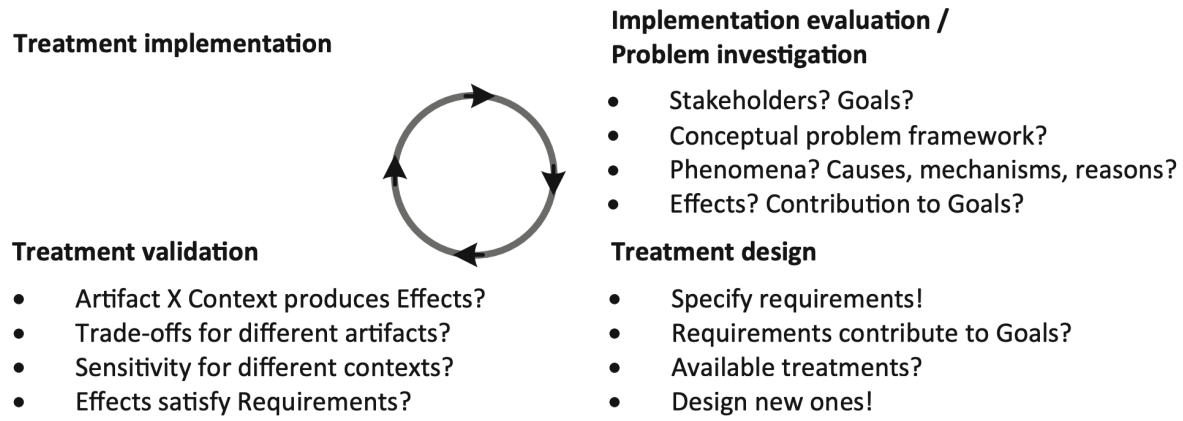

Figure 1.1: The Engineering Cycle
(Wieringa, 2014)

Two methods are chosen to validate the artifact: expert opinion and single-case mechanism experiment. One of the simplest ways to authenticate an artifact is by executing Expert Opinion. A group of experts is provided with the artifact's design and tasked with envisioning how it might interact in hypothetical problem scenarios (Wieringa, 2014). They then predict the expected outcomes of these interactions. The artifact must be redesigned if the projected results do not align with the predefined criteria.

A single-case mechanism experiment is a research approach that centres on investigating a singular instance. This involves introducing specific stimuli and interpreting the following responses based on internal mechanisms within the case (Wieringa, 2014). Through this method, the researcher takes an active role in the case by experimenting. Single-case mechanism experiments hold significance for evaluating the implementation and investigating problems, as they deliver valuable insights into the behavior of elements and challenging circumstances within real-world contexts. This approach empowers the researcher to formulate a series of stimuli that enhance their understanding of

the underlying systems managing various phenomena.

1.3 Problem Statement

Several key considerations arise from the imperative to develop reference architecture of smart tourism practices for developing countries. As elaborated in Chapter 1, developing countries face distinct challenges for effective and ongoing smart tourism management. The lack of resources and standardization of the smart tourism process hinder achieving the project's objective. Based on the literature study and this case study exploration, tourism competitiveness is a prominent keyword highlighted as the objective of smart tourism.

In addition, as explained in Chapter 2, a review of existing literature reveals a significant gap in the discourse concerning smart tourism practices in developing countries, specifically in utilizing an Enterprise Architecture (EA) approach. The potential benefits of applying an EA-based reference model to improve the understanding and management of smart tourism practices in such environments have yet to be sufficiently explored. The tourism industry involves a complex process, including stakeholders, business processes, and technologies. Consequently, this lack of knowledge underlines the need for research into the reference architecture of smart tourism practices in developing countries. This research should focus on exploring the feasibility and benefits of employing EA models to enhance the competitiveness of tourism sites. Such an investigation aims to offer a comprehensive framework that aligns stakeholders' interests, clarifies operational procedures, and supports the long-term growth of smart tourism in developing countries.

1.4 Research Questions

As mentioned in the previous section, the goals have been identified for this thesis. The main and sub-research questions are explained in this section to realize the goal of this thesis.

"How can we improve smart tourism practices for developing countries by designing a reference architecture for smart tourism that supports tourism competitiveness?"

Therefore, to answer the main research question, the following sub-questions have been elaborated below:

Sub Research Questions:

1. **What is state of the art on Smart Tourism enterprise architectures?**

   This study analyzes the state of the art on smart tourism reference architecture. For that, systematic literature is conducted, so a set with the relevant research works in this area can be analyzed and serve as the basis for this thesis.

2. **What is a suitable enterprise architecture based on the reference architecture to conduct the development of smart tourism in developing countries?**

   Based on the foundation set by the systematic literature review, This thesis proposes a smart tourism reference architecture for developing countries based on enterprise architecture. An in-depth exploration of designing the reference architecture is explained in the context of a case study, with the Indonesian Government as the stakeholder.

3. **To what extent does the Indonesian Local Government, as a case study, align with the proposed smart tourism platform reference architecture?**

   A case study analyzing the smart tourism initiatives of the Indonesian Government is conducted to validate the proposed reference architecture. Smart tourism involves various stakeholders, business processes, applications, and technology. Therefore, aligning the proposed reference architecture with the case study is essential.

1.5 Research Scope

This study focuses on the design, delivery, and validation of a reference architecture intended to accelerate the creation of a smart tourism platform tailored for developing countries. This architecture equips governments and collaborators with a contextually flexible, reusable framework. Examining smart tourism platforms in developing countries encompasses engagement from various organizations or business entities within the smart tourism ecosystem. Given the intricate nature of the tourism industry, with each partner involved having complex business processes, this study concentrates on streamlining pivotal activities to be integrated into the instantiation of the architecture.

1.6 Research Structure

This study adheres to the Design Science Research Methodology (DSRM) outlined by R. Wieringa (2014), employing Expert Opinion and Single-Case Mechanism Experiments as validation techniques. Chapter 2 undertakes a systematic literature review (SLR) to establish the succeeding state-of-the-art smart tourism platform reference architecture, addressing the initial research query. Subsequently, Chapter 3 refines this general reference architecture to align with the specifics of developing countries, aligning with the multi-dimensional reference architecture design framework advocated by Angelov et al. (2012). Moving forward, Chapter 4 directly implements the adapted reference architecture into a tangible and operational case study prototype. Thus, Chapter 5 evaluates the perceived impacts of the smart tourism platform designed for developing countries and is validated through a client case study. Finally, Chapter 6 concludes with a discussion of findings, constraints, and recommendations for future research.

Chapter 2

Theoretical Framework

In line with the preceding chapter, the existing cutting-edge reference architecture for smart tourism platforms will be extracted from scholarly journal articles. It is essential to establish a consolidated definition drawing from various studies to enhance comprehension of the subject under study. The subsequent section will elaborate on the process of deriving this definition. Furthermore, as the research aims to develop a reference architecture, explore the knowledge domain, and utilize a guiding framework, these aspects are crucial to understanding the theory. In a later section, some terms that are related to the research will be described to support the foundation of the research.

2.1 Smart Tourism

There are widespread definitions of smart tourism. Throughout this section, the study to assess the variety of the definitions is related. Scholars have discussed three prominent themes. These are "Utilization of technologies," "Real-time data through intelligent technologies," and "Coordination of activity."

The notions of technology utilization are as follows. Smart tourism stands out for its emphasis on people-centered and sustainable scientific and technological advancements. These innovations enhance service quality and tourism experience by leveraging information and communication technologies (ICTs). These factors serve as crucial prerequisites for successfully establishing digital tourism, with its effectiveness contingent on interoperability and a proficient social and human capital base (Pencarelli, 2019). In order to be able to utilize smart tourism, digital literacy skills are essential (Mayor of Pontianak City, 2019). The digital literacy skill set involves grasping and applying data across various formats sourced through computers from various origins. Furthermore, it encapsulates an individual's proficiency in efficiently navigating and accomplishing tasks within digital spaces (of Illinois, 2014). The use of ICTs is emphasized more by Pencarelli; the term "smart tourism" denotes an approach that centers on sustainability, utilizing the Internet and ICT in a manner that integrates technological, human, and social assets. This integration aims to uphold sustainability principles, ultimately enhancing individuals' quality of life and augmenting the overall tourism experience for customers (Pencarelli, 2019).

The integration of traditional tourism practices with "smart" technology presents an innovative tourism framework and a promising route for the progression of the tourism sector. Smart tourism is applying information technology, mobile communication, cloud computing, artificial intelligence, and virtual reality to develop novel tools and methods to improve the tourism industry. (Salvendy & Wei, 2022). Furthermore, Smart tourism can be defined as using mobile digital connectivity to establish a more intelligent, meaningful, and sustainable connection between tourists and the urban environment.

The topic of intelligent tourism has garnered attention and generated many perspectives among scholars within the domestic academic community (Pimentel, McKenney, Firmino, Calvão, & Ayres, 2020). In addition, the phrase "intelligent" is present in the given explanation. Smart Tourism utilizes developing technologies such as social media, mobile devices, and intelligent sensors to collect and use extensive quantities of data to create innovative value propositions (Christou, 2016). Finally, according to scholarly sources, one of the definitions of smart tourism involves utilizing intelligent technology to analyze real-time data.

The use of smart technologies to gain real-time data is widely discussed within the smart tourism domain. Smart tourism aims to create inventive methods for obtaining and adapting real-time tourism data using mobile internet or internet-enabled devices (Cepeda-Pacheco & Domingo, 2022). Mikhailov supports this statement that smart tourism is characterized by the gathering and analysis of data from diverse origins, coupled with the application of advanced information technologies, to enhance travel experiences to be more enriched, efficient, and sustainable (Mikhailov, Kashevnik, & Smirnov, 2020). The real-time data provided by smart technologies brings some benefits to the stakeholders. Smart cities become smart tourist destinations when they improve the travel experience for tourists, offer intelligent platforms for collecting and sharing information, enable effective allocation of tourism resources, and integrate tourism providers at both large and small scales (Buhalis & Amaranggana, 2013). Smart tourism is an emerging form integrated into the broader concept of a smarter earth or city. In essence, smart tourism centers on addressing tourists' requirements by integrating intelligent information technology with informal cultural elements and innovative tourist industry practices, all aimed at enhancing the quality of tourism services, elevating the standards of tourism management, and expanding the scope of the modern engineering sector within the industry (Huang, Yuan, & Shi, 2012). At its core, a tourism resource data center or smart tourism platform is fortified by IoT and a tourism cloud. This is complemented by more sophisticated identification methods, intelligent monitoring, and location services to aid government, businesses, and residents (Huang et al., 2012). Thus, identifying the related stakeholders is essential for smart tourism execution and brings the topic to the following prominent theme: activity coordination.

Several scholars argue smart tourism involves coordinated initiatives between stakeholders to utilize technologies. Smart tourism can be defined as a mobile information system that uses the physical information infrastructure in a tourism context to create a new kind of experience for tourists. The concept of smart tourism necessitates a comprehensive understanding encompassing integrating technology, processes, and management (Koo, Yoo, Lee, & Zanker, 2016). Furthermore, smart tourism can be defined as a form of tourism that contains organized activities at a specific destination to collect and utilize data. This data utilization aims to create on-site experiences and commercial prospects, optimizing efficiency and sustainability while enhancing the entire visitor experience (Gretzel, Sigala, Xiang, & Koo, 2015). Another characteristic that has been discussed is the concept of tourism that leverages coordinated efforts at a destination to collect and integrate data from diverse sources, such as physical infrastructure, social networks, governmental and organizational channels, and human interactions. This

approach also involves utilizing modern technologies to transform this data into on-site experiences and business prospects. The primary objective is to optimize overall operational effectiveness, ecological viability, and tourist satisfaction (Roopchund, 2020).

Furthermore, to optimize the overall experience of tourists, it is recommended that all relevant parties actively engage in a cooperative endeavor to augment the competitive edge of the destination (Buhalis & Amaranggana, 2013). Smart tourism involves the active participation of local citizens in implementing smart tourism initiatives. This method provides services to tourists, tourism enterprises, and the government and promotes harmonic cooperation between tourism management, services, and the economic advancement of destinations. The primary objective is to foster a harmonious relationship between tourists and members of the local community (Wei, Wang, & Liu, 2020).

The present systematic literature review focuses on the definition of smart tourism, which encompasses integrating technologies, utilizing real-time data through intelligent technologies, and coordinating activities. According to the above definitions, smart tourism is a well-coordinated activity that leverages advanced technologies to gather real-time data to enhance travel experiences. The present idea is anticipated to include the definitions of smart tourism as established by existing scholarly research.

2.2 Enterprise Architecture

As a set of principles that support this thesis, the term "Enterprise architecture" is elaborated through this section. The terms are broken down into two, which are "Enterprise" and "Architecture". An enterprise is a set of organizations with the same goals and conditions (Open Group, 2009). Following up, architecture is the essential part of the system of an organization and its components, the interrelations between the elements, its impact on the environment, and the guide of design and evolution (IEEE, 2000). Finally, by combining those words, the term enterprise architecture comes to a surface. The definition of enterprise architecture is the core of an organization that incorporates principles, methods, and models utilized in the design and implementation of the organization, including the organizational structure, business processes, information systems, and infrastructure (Lankhorst, 2017).

Enterprise architecture includes the essential elements of an organization. Enterprise architecture includes the business process, IT infrastructure, and continuous development and transformation. This discipline proposes essential elements that are stable rather than solutions created for each problem. The role of architecture is to maintain the fundamental part of the business while allowing it to be flexible and adaptive. Therefore, to gain business success, it is essential to have architecture (Lankhorst, 2017).

2.3 TOGAF

Various architecture frameworks are published to give additional insight into several factors within EA. The architecture framework elaborates the architecture description

techniques by defining and creating a relation between the viewpoints and modeling connected to the architecture (Lankhorst, 2017). One of the frameworks is The Open Group Architecture Framework (TOGAF). The initial objective of The TOGAF was to serve as an extensive tool for crafting technical architectures. However, its evolution over time has expanded its scope, including enterprise architecture as a framework and methodology (Open Group, 2009).

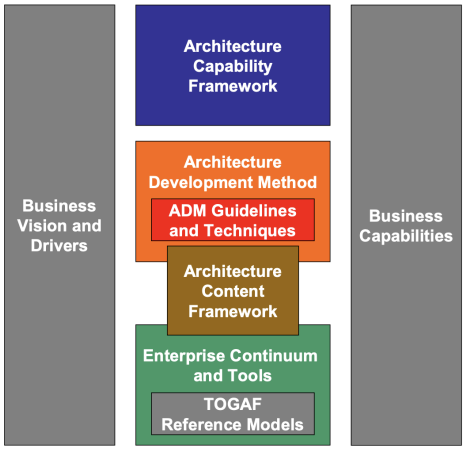

Figure 2.1: TOGAF 9
(Open Group, 2009)

The essential elements of TOGAF are visualized in Figure 2.1.

1. The Architectural Capability Framework addresses the vital components needed to establish and operate an architectural function within a company. These elements enclose the organization, procedures, skills, roles, and responsibilities.

2. The Architecture Development Method (ADM) provides architects with a structured approach to guide their work. Recognized as the central element of The Open Group Architecture Framework (TOGAF), ADM offers a systematic and iterative methodology to navigate the design and development of enterprise architecture as a whole.

3. The Architecture Content Framework proposes that an enterprise architecture can be interconnected by four architectures: Business Architecture, Data Architecture, Application Architecture, and Technology (IT) Architecture.

4. The Enterprise Continuum encompasses various reference models, including the Technical Reference Model. At its core, the Enterprise Continuum visually describes the architectural development process, from foundational architectures to widely adopted systems architectures and further to designs specialized for specific industries, culminating in an organization's unique and distinct architecture.

2.4 Modelling Languages

After studying the framework used to facilitate Enterprise Architecture (EA), examining the modeling language that supports such a framework is essential. The concepts of ArchiMate and LeanIX meta-model are distinct and intended for various audiences in the field of enterprise architecture. ArchiMate primarily aims to establish a uniform language for modeling (Open Group, 2021), whereas the LeanIX meta-model enables tailoring and adjustment to meet individual and organizational needs (LeanIX, 2024).

2.4.1 ArchiMate Language

ArchiMate stands out as a mature modeling language that has gained a reputation. ArchiMate is a standardized, user-friendly language that models and visually represents organizational architectures and has established itself as the principal standard for describing architecture within the framework of TOGAF, which the Open Group has developed (Lankhorst, Proper, & Jonkers, 2009).

Furthermore, it is essential to highlight that the Archimate language goes beyond visual portrayals composed of shapes and lines. It also incorporates an extensive meta-model, which clarifies the diverse entities involved and effectively conveys their architectural value (Lankhorst et al., 2009). The ArchiMate framework serves as an enterprise architecture (EA) platform, allowing for the comprehensive modeling of an enterprise from various viewpoints (Open Group, 2021). Within this framework, distinct "Layers" exist that correspond to different levels of enterprise modeling using the ArchiMate language. These layers encompass Strategy, Motivation, Business, Application, Technology, and Implementation and migration. The visual representation is illustrated in Figure 2.2.

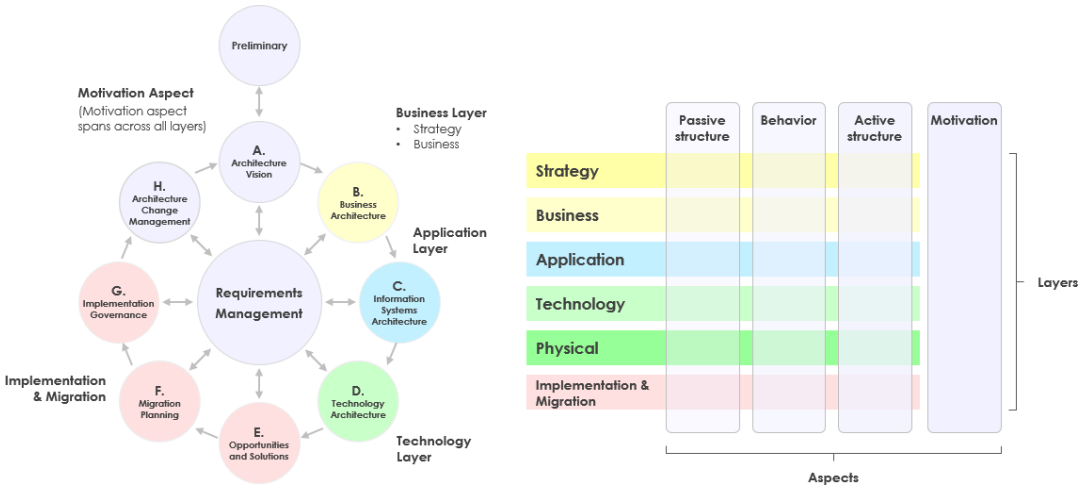

Figure 2.2: Archimate to TOGAF Mapping

2.4.2 LeanIX Meta Model

LeanIX offers an Enterprise Architecture Management (EAM) solution with a preconfigured metamodel. This Meta Model helps align the architecture with other tools and allows for the appropriate architecture design based on specific requirements (LeanIX, 2024).

Implementing the Meta Model will guarantee good operations through the overall person in the team since they have a common understanding of the configuration. The Meta Model comprises four layers applicable to end-to-end business and technology transformations (LeanIX, 2024). The four layers are strategy and transformation, business architecture, application and data architecture, and technical architecture. The essential structure of the LeanIX Meta Model is named Fact Sheet types. The 12 distinct Fact Sheet types in the Meta Model v4 are detailed below. On the type level, relations, attributes, subscriptions, tags, access, and more are defined. The figure 2.3 below illustrates the relationship between the different types of Fact Sheets.

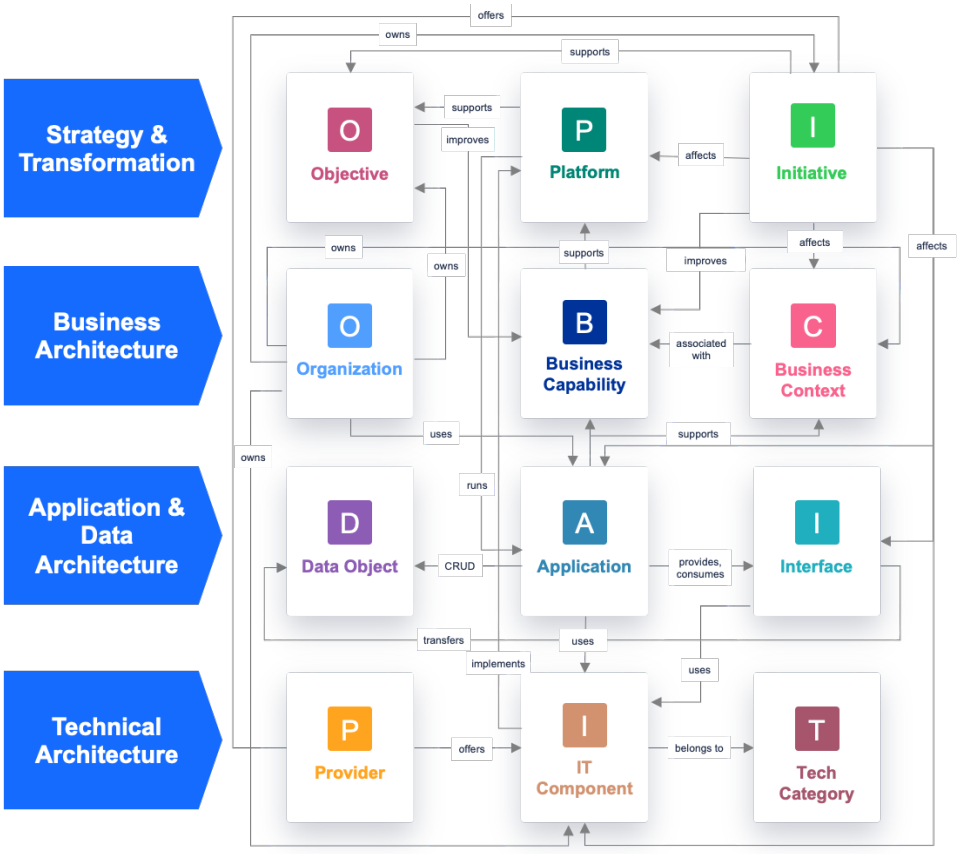

Figure 2.3: LeanIX Meta Model

2.4.3 Alignment of ArchiMate and LeanIX

The alignment of the meta-model is essential to preserve the correlation between LeanIX and ArchiMate. The comparative study of the LeanIX and ArchiMate meta-models discloses an intersection. Thus, the elaboration of the meta-model alignment is written based on the ArchiMate and LeanIX meta-model descriptions (Open Group, 2021), (LeanIX, 2024). The alignment is shown in Table 2.1 below.

Table 2.1: Meta Model Alignment

No.	LeanIX	ArchiMate
1	Application	Application Component
2	Business Capability	Business Function
3	Data Object	Data Object
4	Interface	Application Interface
5	IT Component	Technology Node
6	Process	Business Process
7	Project	Plateau
8	Provider	Node (network node)
9	User Group	Stakeholder

The' Application' element in LeanIX parallels the 'Application Component' in ArchiMate, both serving as modular units in software or IT service configurations. The 'Business Capability' in LeanIX, which abstracts the operational functions of a business, corresponds to the 'Business Function' in ArchiMate. The role of 'Data Objects' is consistently maintained across both modeling languages, representing key elements in the handling and generating of informational assets. Similarly, the 'Interface' in LeanIX finds its equivalent in the 'Application Interface' of ArchiMate, each representing essential points of interaction or communication within their respective systems. In the infrastructure domain, LeanIX's 'IT Component' shares attributes with ArchiMate's 'Technology Node,' each encapsulating essential elements of IT infrastructure. Regarding process mapping, 'Processes' in LeanIX align with 'Business Processes' in ArchiMate, highlighting the sequential dynamics of business operations. In LeanIX, 'Projects' represent IT-focused initiatives and can be compared to ArchiMate's 'Plateau or Work Package,' although the latter may include a wider range of organizational change activities. The 'Provider' in LeanIX, indicative of service delivery mechanisms, corresponds to the 'Node' in ArchiMate. Finally, the 'User Group' in LeanIX aligns with the 'Stakeholder' in ArchiMate, identifying individuals or groups with interests or influence over the architectural framework.

This comparative analysis highlights shared themes between LeanIX and ArchiMate. It brings to light subtle distinctions that define their unique approaches to the complex interplay of business processes, technological infrastructure, and organizational dynamics. Therefore, this alignment will be representative of the reference architecture to be presented in the case study through LeanIX and ArchiMate and make sure both architectures are coherent with each other.

2.5 Reference Architecture Design Framework

The definition of reference architecture is a simplified representation of components, outlining their primary functions and interactions. It encapsulates the fundamental aspects of current software systems within a specific domain and provides a framework for the architectural blueprint of new software systems. (Garcés et al., 2021). This explanation is supported by an alternate definition, which claims that a reference architecture is a reference architecture is an "abstraction of concrete software architectures in a certain domain" (Angelov, Grefen, & Greefhorst, 2012). This highlights the foundational role of system architectures in a specific field. A reference architecture outlines the core functionality needed within a particular domain or to tackle a specific set of problems. It outlines the difference between each functionality and depicts the exchange of information among its components.

Afterward, this classification approach was developed by Angelov to design a new reference architecture through a framework (Angelov et al., 2012). As illustrated in Figure 2.4 above, the methodology includes selecting the designs and the architectural purpose to use the framework and create the organizational context. Then, there is a comparison process to observe the correlations between five reference architecture types identified until a match is found. Furthermore, the stakeholders will be interviewed to confirm the description type, architectural element, formalization, and abstraction level.

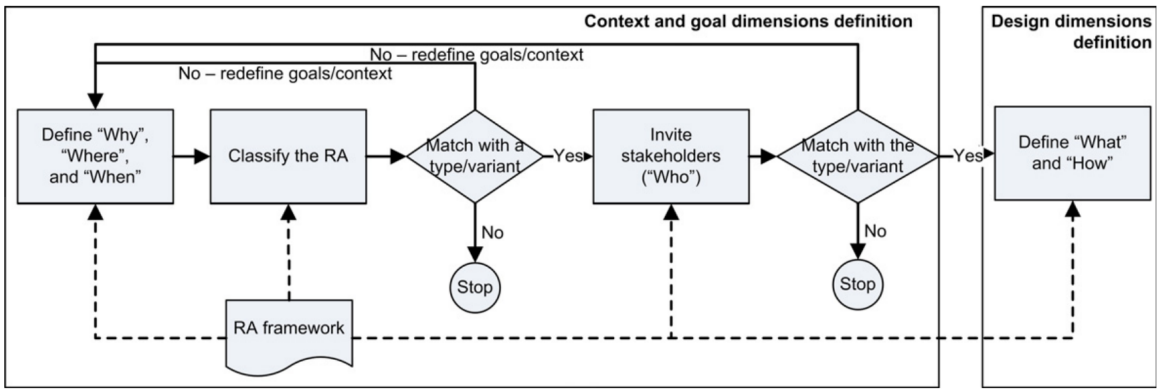

Figure 2.4: Framework to Design Reference Architecture
(Angelov et al., 2012)

Following a design method for crafting reference architectures is crucial to ensure the reference architecture is solid, credible, and relevant. Thus, the process by Angelov and Galster shows a similar pattern and is followed by this thesis to do research. The process is elaborated in Figure 2.5.

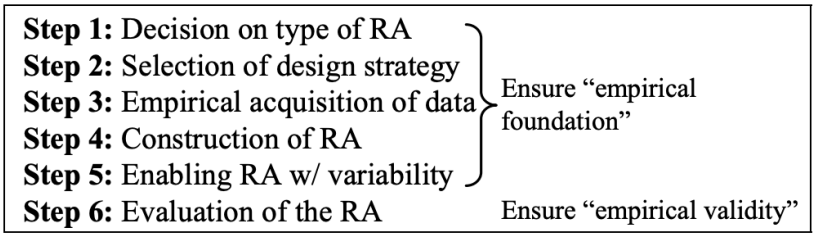

Figure 2.5: Empirically-Grounded RA
(Galster & Avgeriou, 2011)

Stage 1: Decide on type of RA

Deciding a type of reference architecture helps define its planned purpose and the suitable framework for its application (Galster & Avgeriou, 2011). A characterization framework outlines five distinct categories of robotic assistants (RAs). These categories are determined based on why, when, and where they are created (Angelov, Grefen, & Greefhorst, 2009).

This presented characterization framework categorizes RAs into five categories based on their objectives, timing, and organization (Angelov et al., 2009). As a result of the elaboration above, RAs can be categorized into the following five types:

1. Classical, standardized architectures across various organizations.
2. Classical, standardized architectures within a single organization.
3. Classical, facilitation reference architectures for multiple organizations in collaboration between software and user organizations.
4. Classical, facilitation architectures within a single organization.
5. Preliminary facilitation architectures intended for implementation across multiple organizations. Additional details about these categories can be found here.

Stage 2: Selection of design strategy

In this research, there is an analysis and differentiation between two separate design approaches: Formulate the design of the RA from its initial phases. The following design approach generates the RA design by incorporating pre-existing architectural elements(Galster & Avgeriou, 2011).

The choice of design approach depends on the RA type. For a developing research assistant (RA) type, the RA is developed from scratch without any existing design. In the case of a classical type, the design process is guided by pre-existing architectural elements. This design approach also impacts the selection of data sources necessary for the empirically grounded assessment (Galster & Avgeriou, 2011).

Stage 3: Empirical acquisition of data

Identifying data sources is an essential step in acquiring empirical data. The choice of RA type and design approach from earlier stages impacts the selection of data sources. In the case of classical RAs, existing documentation can be utilized, whereas preliminary RAs require additional documents and people. A deep understanding of the platform is essential for platform-specific RAs, while industry-specific RAs need familiarity with specific business processes (Galster & Avgeriou, 2011).

Data sources mainly contain information from various partakers, including consumers, users, and researchers. Additionally, data can be sourced from diverse systems, encompassing documentation and source code. Moreover, publications and documents such as technical reports and white papers can offer valuable data repositories (Nakagawa, Becker, & Maldonado, 2013).

Stage 4: Construction of RA

The basic structure of the RA can be derived from Step 3 and contains key architectural elements, such as shared stakeholders, perspectives, and types of models, following ISO/IEC 42010. The identified building blocks obtained from the data in Step 3 should be cross-referenced to identify any shared elements. These shared elements can be integrated as components of the RA. When instantiating the RA, it is possible to hide certain architectural elements and raise them with specific data, facilitating customization.

Stage 5: Enabling RA with variability

The instantiation of the RA is required to incorporate adaptability. Using the empirical data collected in earlier stages allows for identifying areas in the design where adaptability is needed for instantiation. The stage five of this research is elaborated in Chapter 4. There are three potential approaches to enable this adaptability (Galster & Avgeriou, 2011):

1. **Annotation of RA.** Annotation requires identifying and labeling elements within an architectural model with relevant attributes regarding variability, which can be done through attributes or rules.

2. **Variability models.** The RA description is related to ISO/IEC 42010 and allows the establishing of specific variability models.

3. **Variability views.** Employing variability views allows for considering variability-related concerns from different perspectives.

Stage 6: Evaluation of the RA

To complement the framework by Angelov that answers the "Why," "Where," "When," and "Who" of the reference architecture in Figure 2.4, another framework is suggested. The framework by Nakagawa added a process to evaluate that answers the "What" of the reference architecture. Evaluation refers to analyzing the architectural description of a reference architecture with various stakeholders to find mistakes in the definition (Nakagawa, Guessi, Maldonado, Feitosa, & Oquendo, 2014). The reference architecture performance can be empirically evaluated within a specific project context. Architecture value within a project can be determined by assessing its practicality. The quality of the RA is evaluated in two dimensions: firstly, the accuracy and usefulness of the RA itself, and secondly, the level of support it provides for effective adaptation and implementation (Galster & Avgeriou, 2011).

Checklists can be employed to appraise the quality. A set of questions can guide reviewers in their assessment process. These checklists can be expanded to contain criteria for evaluating the effectiveness of RAs. These criteria may involve attributes like adaptability, understandability, accessibility within an organization, and the inclusion of central issues of specific domains (Galster & Avgeriou, 2011). The checklist is a set of criteria that reviewers can use to assist them in finding mistakes in the documentation, especially those that refer to reference architectures (J. F. M. Santos & Nakagawa, 2013).

2.6 Systematic Literature Review (SLR)

This section embarks on a systematic literature review (SLR) to delve into the most recent advancements and acquire the components of the envisioned comprehensive reference architecture for smart tourism. The subsequent sections will expound upon the methodologies employed to steer this SLR, along with an analysis of the outcomes and the discerned reference architecture for the smart tourism platform, which will be discussed in this chapter.

2.6.1 SLR Methodology

As mentioned in the chapter, the study will base the existing reference architecture on scholarly journal publications. To address the research questions outlined earlier, SLR has been chosen as the research methodology. This decision was made because an SLR can provide an unbiased examination of the existing body of literature. The findings of this study will also guide the author's master thesis, which will be a research endeavor.

To conduct this literature review (SLR), the insights and approaches have been drawn from research studies (Kitchenham & Charters, 2007), (Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015a). In the following sub-chapters, the chapter will provide explanations of the procedures employed in this systematic literature review.

2.6.2 SLR Planning

A systematic literature review requires a meticulously structured approach to guarantee a thorough and methodical examination of the existing research. The design for this systematic literature review draws inspiration from the methodology articulated in the study conducted by Kitchenham (Kitchenham & Charters, 2007). A concise overview of the planning process for this SLR is provided in Table 2.2.

Table 2.2: SLR Planning

Planning	
1	Define Main the Research Question and its Sub-Questions
2	Select Scientific Databases
3	Formulate Search Query
4	Define Inclusion and Exclusion Criteria
Selection	
5	Execute Formulated Search Queries
6	Article Selection Based on Inclusion Criteria
7	Remove Duplicate Studies from Scientific Databases
8	Article Selection Based on Exclusion Criteria and Abstract
Result Analysis	
10	Extract and Analyze Papers According to Define Research Questions
11	Synthesize Result and Conclusion

2.6.3 SLR Research Question

The following research questions were identified:

Main Research Question:

1. What is the state of the art on Smart Tourism enterprise architectures?

Sub Research Questions:

1. What are the motivations and challenges for the adoption of Smart Tourism?
2. What type of technology is used within Smart Tourism digital ecosystems?
3. How can the Smart Tourism reference architecture be developed through a comprehensive literature analysis?

Scientific Databases

This study has selected three databases to access scholarly papers and effectively address the research questions.

1. Scopus (https://www.scopus.com)
2. Web of Science (https://webofscience.com)
3. IEEE (https://ieeexplore.ieee.org)

The databases have been chosen because they contain a range of literature in our research area. Additionally, these databases are highly considered among the five reputable repositories for academic resources.

Search Query Formulation

A planned keyword selection process was undertaken to formulate proficient search queries for the scientific databases used in this systematic literature review (SLR). The chosen keywords for this SLR were extracted directly from the research questions. The keywords are "enterprise architecture," "smart tourism," "smart governance," "hospitality," and "government." Furthermore, the refinement of keywords was achieved by identifying and including synonyms and categorizing them accordingly, including artifact, smart tourism, industry area, and organization structure. Table 2.3 presents the specified keywords for this literature review.

Table 2.3: Query Search Keywords

Artifact	Smart Tourism	Industry Area	Organization Structure
Enterprise architecture	Smart tourism	Tourism	Organization
Reference	Smart governance	Leisure	Business
Architecture	Smart tourism destination	Hospitality	Government
Pattern		Travel	Supply chain
		Hotel	Ecosystem
			Networked business

Based on the keywords presented in Table 2.3, search queries were systematically devised, conforming to the distinct rules and syntax prescribed by each scientific database in this investigation. The queries used for each database are listed below:

1. Scopus (https://www.scopus.com/search/form.uri?display=advanced)

   TITLE-ABS-KEY (
   ("Enterprise architecture" OR Reference OR Architecture OR Pattern)
   AND
   ("Smart tourism" OR "Smart governance" OR "Smart tourism destination")
   AND
   (Tourism OR Leisure OR Hospitality OR Travel OR Hotel)
   AND
   (Organization OR business OR Government OR "Supply chain" OR Ecosystem OR "Networked Business")
)

2. Web of Science (https://webofscience.com)

   TS= (("Enterprise architecture" OR Reference OR Architecture OR Pattern) AND ("Smart tourism" OR "Smart governance" OR "Smart tourism destination") AND (Tourism OR Leisure OR Hospitality OR Travel OR Hotel) AND (Organization OR business OR Government OR "Supply chain" OR Ecosystem OR "Networked Business"))
   OR
   TI= (("Enterprise architecture" OR Reference OR Architecture OR Pattern) AND ("Smart tourism" OR "Smart governance" OR "Smart tourism destination") AND (Tourism OR Leisure OR Hospitality OR Travel OR Hotel) AND (Organization OR business OR Government OR "Supply chain" OR Ecosystem OR "Networked Business"))

OR
AB= (("Enterprise architecture" OR Reference OR Architecture OR Pattern) AND ("Smart tourism" OR "Smart governance" OR "Smart tourism destination") AND (Tourism OR Leisure OR Hospitality OR Travel OR Hotel) AND (Organization OR business OR Government OR "Supply chain" OR Ecosystem OR "Networked Business"))

3. IEEE (https://ieeexplore.ieee.org)

("Enterprise architecture" OR reference OR architecture OR Pattern)
AND
("Smart tourism" OR "smart governance" OR "smart tourism destination")
AND
(Tourism OR leisure OR hospitality OR travel OR hotel)
AND
(Organization OR business OR government OR "supply chain" OR ecosystem OR "networked business"))

Inclusion and Exclusion Criteria

Explicit inclusion and exclusion criteria must be established to improve the precision of the search results produced by the queries. This stage involves setting the criteria to determine whether articles would be included in the body of literature. Articles that met the inclusion criteria were included in the study, whereas those that completed the exclusion criteria were not. This process step was crucial in preserving the accuracy and upholding the necessary levels of excellence and rigor in the evaluated literature, in line with the needs of this investigation.

Inclusion Criteria

1. Inclusion of literature from all years.
2. Inclusion of literature conducted in English.
3. Inclusion of study areas within Computer Science, Engineering, Business Management and Accounting, Tourism, and Social Science.

Exclusion Criteria

1. Exclusion of duplicate literature across databases.
2. Exclusion of studies that are either unavailable or incomplete.
3. Exclusion of studies with insufficient information, specifically those referencing the keywords but lacking relevance to the research questions.

This study's inclusion criteria include any English-language articles from any year. This was created with a broader understanding of the topic and went through an international peer review process. To ensure the study's relevance to the research issues, it also involves computer science, engineering, business management and accounting, tourism, and social science.

Exclusion criteria have been established to guarantee the relevancy of the literature studied in this research. Duplicate publications, inaccessible journals, and incomplete articles must be removed to do this. The titles, abstracts, and contents of publications unrelated to the research topic are also disregarded.

2.6.4 SLR Selection

This section presents the outcomes of the query execution process. Query execution was conducted twice, employing two queries to identify relevant studies. The initial query resulted in 131 literature results sourced from three different scientific databases. After the inclusion and exclusion criteria were applied, the following phase was undertaken to determine the paper's relevance to this systematic literature review. The stage is selecting the paper based on the title and the abstract to narrow the amount. Afterward, read the full-text paper to choose the final articles. Following a detailed review, the last count of relevant literature was reduced to 31 full-text available papers.

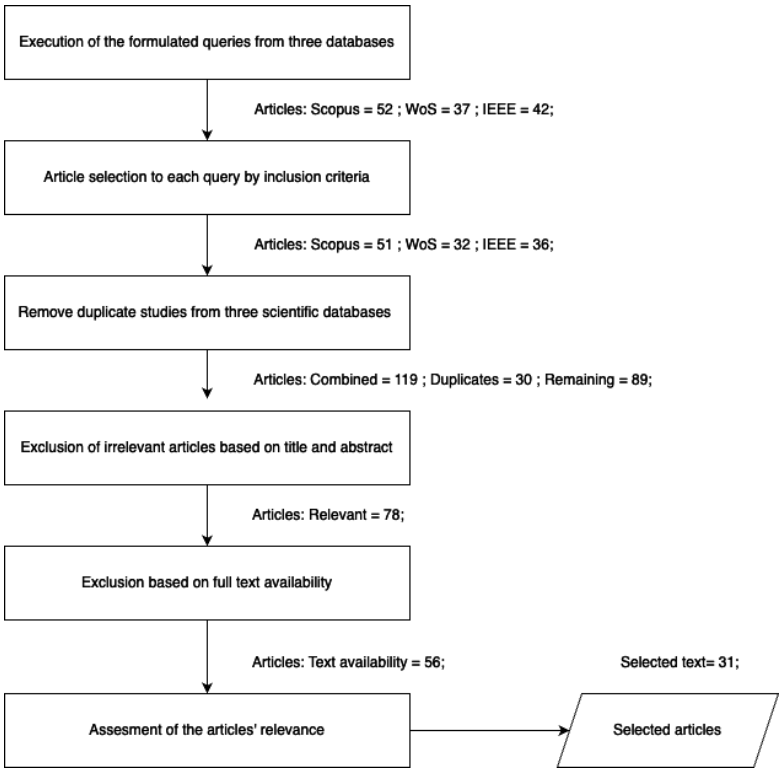

Figure 2.6: SLR Papers Selection Flowchart

2.6.5 SLR Data Extraction

Following the application of the inclusion and exclusion criteria, the information in this part was extracted from the literature. Quantitative and qualitative stages comprise the data extraction process. The goal is to provide a thorough overview of the present body of literature by combining quantitative and qualitative analysis methods.

2.6.6 SLR Result Analysis

A quantitative analysis is undertaken to determine the goal of the literature, the research methods used, and the context relevant to this Systematic Literature Review (SLR). The study's quantitative analysis will be presented in two tables arranged by reference and target. Six categories are used to categorize the target: smart tourism (ST), motivation for adopting smart tourism (M), difficulties to adopting smart tourism (C), technology in smart tourism (T), government's role in smart tourism (G), and architectural layers (AL).

Table 2.4: Quantitative Analysis Based on Target

No	Reference	Target					
		ST	M	C	T	G	AL
P1	(Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015b)	√	√		√		
P2	(kuanrong & guili, 2017)		√		√		
P3	(Wei, Wang, & Liu, 2020)	√	√		√	√	
P4	(Verma, Shukla, & Sharma, 2021)		√		√		√
P5	(Tsai et al., 2018)	√	√		√	√	
P6	(Salvendy & Wei, 2022)	√	√	√	√		
P7	(Pencarelli, 2019)	√	√			√	
P8	(Subakti & Putra, 2020)	√	√	√	√	√	√
P9	(Brandt, Bendler, & Neumann, 2017)	√	√		√	√	
P10	(Guerra, Borges, Padr˜ao, Tavares, & Padr˜ao, 2017)		√			√	
P11	(Sabbioni, Villano, & Corradi, 2022)	√	√				√
P12	(Zhu & Shang, 2021)		√				√
P13	(Qin & Pan, 2023)	√	√		√	√	√
P14	(Pereira, Sousa, Barata, Oliveira, & Monsieur, 2015)		√	√	√	√	√
P15	(Nurnawati & Ermawati, 2018)		√		√	√	
P16	(Mikhailov, Kashevnik, & Smirnov, 2020)	√	√	√	√		√
P17	(Gusakov, Haque, & Jogia, 2020)	√	√			√	
P18	(Roopchund, 2020)	√	√	√	√	√	√
P19	(Lv, 2022)	√	√	√	√	√	
P20	(Girish Kumar, Nand, & Bali, 2022)		√	√	√		√
P21	(Koshizuka & Mano, 2022)		√		√		√
P22	(Kansakar, Munir, & Shabani, 2018)		√	√	√		√
P23	(Sharma, Rishi, & Sharma, 2020)		√		√		√
P24	(Gu, Song, Wang, & Jin, 2018)			√	√		√
P25	(Ependi et al., 2019)		√	√	√	√	√
P26	(Vecchio, Mele, Ndou, & Secundo, 2018)	√	√		√		√
P27	(Huang, Yuan, & Shi, 2012)	√	√	√			√
P28	(Cepeda-Pacheco & Domingo, 2022)	√	√		√		√
P29	(Zhang, Ning, Zhang, Wang, & Lee, 2019)			√	√		
P30	(Antonio, Correia, & Ribeiro, 2020)		√		√	√	
P31	(Angelaccio, Basili, & Buttarazzi, 2013)		√		√	√	√

The categories are mapped as mentioned to answer the research questions of the systematic literature reviews. The categories are constructed as the primary coding theme in the pieces of literature throughout the SLR process. Under the main coding theme, several keywords are found related to the smart tourism reference architecture. Thus, the relations between keywords constructed a main coding theme presented as the target in the table. It shows the relevancy and insights of the papers to this research. The table 2.4 above summarizes the quantitative analysis of the literature reviews based on the focus.

2.6.7 Motivations of Smart Tourism Adoptions

To explore the motivations behind adopting smart tourism, the work of Lankhorst defines Motivation as the underlying factors that shape the design of an enterprise architecture (Lankhorst, 2017). In simpler terms, these are the considerations influencing architectural decisions. In the context of Enterprise Architecture (EA) practice, Motivation encompasses several crucial concepts, which will be discussed in this subsection. The initial idea is the Driver, denoting an internal or external circumstance that prompts an organization to establish its objectives and implement necessary changes. The Goal represents a high-level statement of an organization's intent or the desired outcome. A set of statements, called Requirements, should also be defined to support these Goals.

The drivers are categorized into four types to define the motivations clearly. The first driver is a resource derived from the state in which the stakeholders within smart tourism are located in various places that hindered the process because of limited resources such as funds, human resources, time, skill, and knowledge. Thus, smart tourism needs to improve resource usage efficiency by using the right technology and improving the overall service quality through further business processes (Roopchund, 2020). The second driver is the economy. As one of the main objectives of a business, the government also needs to increase its revenue by implementing smart tourism (kuanrong & guili, 2017). Furthermore, improve local business's social and economic conditions with proper implementation (Pereira, Sousa, Barata, Oliveira, & Monsieur, 2015).

The following driver is competitiveness. Technological advancements are causing significant changes in the tourism industry as they make the tourism stakeholders participate in new markets, opportunities, management practices, and competitive strategies (Roopchund, 2020). As the stakeholders in smart tourism are different, there is a need to improve their users' needs (Qin & Pan, 2023). Furthermore, to enrich the tourists' experience through smart tourism, it is recommended that all parties are also involved in the co-creation process to increase destination competitiveness (Cepeda-Pacheco & Domingo, 2022). The last driver is standardization. The government plays a significant role in the development of Smart Tourism, and it is a guideline for the digitalization of tourism in the design phase (Roopchund, 2020). At the macro level, the government must implement policies and regulations to provide a national framework for Smart Tourism. Table 2.5 presents the identified concepts of Driver, Goal, and Requirements derived from the extracted data, along with the corresponding references they were summarized from.

Table 2.5: Motivations of Smart Tourism Adoption

No.	Driver	Goal	Requirements
1.	Resource	- Increase efficiency [P26, P18, P22, P13, P2, P1] - Achieve sustainability [P1, P18] - Environmental optimization [P1, P4, P2] - Improvement of decision-making process [P26] - Improve quality of life [P8]	- Technology mediation [P26, P18] - Decision making through data processing [P26, P19] - Use of technologies to transform data into tourism on-site experience [P26] - Cost-saving policies [P22, P12] - Guidance for management [P13] - Implement smart tourism platform [P2] - Automation process [P1] - Gamified application [P1]
2.	Economy	- Local economic growth [P14, P10] - Increase government revenue [P2, P4, P1, P8] - Improve social benefits [P2, P1]	- Aiding the creation of local business [P14] - Building intelligent infrastructure [P18, P13, P1, P27] - Shifting to smart governance [P18,] - Use of open and big data [P18, P14, P26] - Reduce cost [P18, P31, P3] - Enable demand forecasting [P26]
3.	Competitiveness	- Enhancement of tourists' experience [P26, P18, P30, P23, P16, P13, P3, P5, P4] - Satisfy user needs [P26, P18, P30, P22, P16, P13, P14, P5, P2, P26]	- Automated digital monitoring of digital experience [P26, P13, P6, P8] - Boosting online reputation [P30, P18, P26, P5] - Implement cross marketing [P30] - Use of IoT-empowered technologie [P23] - Involvement of stakeholders in the co-creation process [P28, P26, P7, P18] - Improve the employees' skills [P13]
4.	Standardization	- Facilitate business ecosystem interconnectedness [P26, P18, P23, P17, P13, P1] - Increase the degree of trust between stakeholders [P17, P26]	- Standardise the framework of smart tourism [P18] - Cooperation facilitated by government [P17, P13, P18, P6, P27, P19] - Integration of smart tourism information and services [P11, P1, P14, P13, P27, P15] - Enable smart tourism ecosystem [P26] - Compliance with standard [P18, P27 P17, P11] - Implement open standardize interface [P22]

The research indicates that drivers and goals influence smart tourism. One focuses on managing resources to enhance operations, promote sustainability, and achieve positive environmental outcomes. Technology plays a role in our lives, aiding us in tasks like data processing and informed decision-making. Additionally, technology helps us create on-site experiences, all aiming to achieve these objectives. Some strategies can significantly improve resource management in tourism.

These strategies include implementing measures to save costs, providing guidelines for managers to adopt automation, and integrating applications. Another crucial aspect is progress, which aims to promote economic development, increase government revenue, and provide social benefits to stakeholders in the smart tourism sector. This driver is implemented by supporting businesses developing advanced infrastructure and establishing effective governance structures. Furthermore, the utilization of data, along with cost reduction strategies and predictive analysis, plays a role in achieving economic objectives within the scope of smart tourism. The other driver that scholars have highlighted is competitiveness. As one of the definitions of smart tourism is how to utilize technology to improve tourists' experiences, it becomes one of the goals that support the driver of competitiveness. In addition, smart tourism needs to be able to meet the needs of the tourists, involve automated monitoring, and implement marketing strategies to build a solid online reputation.

Furthermore, incorporating the Internet of Things (IoT) enabled technology, active involvement of stakeholders in the collaborative process, upgrading of human skills, and effective management of online reputation jointly contribute to strengthening competitiveness in smart tourism enterprises. By prioritizing these initiatives, the smart tourism industry aspires to maintain a leading position in an ever-changing and highly competitive global environment.

2.6.8 Challenges of Smart Tourism Adoptions

Enterprises are intricate entities comprising various social, technical, and infrastructural elements. To maintain competitiveness in the rapidly evolving digital landscape, organizations must be able to adjust to changes (Brée & Karger, 2022) swiftly. Thus, this systematic literature review classifies the challenges of the Enterprise Architecture Management (EAM) task. The tasks are organized into strategic and operational tasks. The strategic functions encompass EA documentation, EA planning, and EA programming.

On the other hand, the operational tasks involve EA implementation, EA communication and support, and EA governance (Schmidt & Buxmann, 2011). Based on Schmidt, EA Documentation is a crucial tool in handling the complexities of the existing architecture. EA planning involves systematically developing descriptions for the target architecture, aligning with overarching and ongoing requirements. EA Implementation consists of the beginning and execution of system modifications under the concept of the EAM. EA Communications involves clear communication and support, along with stakeholder cooperation. EA Governance pertains to the extent to which organizational EA-related directives and choices hold authority. Finally, EA Programming entails the establishment of architectural guidelines and standards that must be adjusted to project changes, including making reference architecture.

The different dimensions of EAM tasks mentioned present unique challenges that must be adequately addressed to achieve successful implementation (Brée & Karger, 2022). Table 2.6 elaborates the challenges that have been identified and their relations to the EAM tasks, as well as the relevant references.

Table 2.6: Challenges of Smart Tourism Adoption

Challenges of smart tourism's adoptions

No.	Challenges	Synthesis	EAM Task Dimensions					
			T1	T2	T3	T4	T5	T6
1.	Lack of research [P29, P27]	Research on smart tourism is still in its early stages and needs more in-depth exploration. One issue with existing literature reviews in this field is that they often lack sufficient references and comprehensive analysis of all available data related to smart tourism. [P29]	√		√			
2.	High-cost [P14, P20]	This method is expensive and not practical for most cities. The number of visitors is usually not high enough to cover the costs, and local governments are not equipped to match the speed of technological advancements, as they are not specialized software developers. [P14]			√		√	
3.	Lack of resource [P19, P18, P16]	Small island nations face distinct challenges compared to developed economies because they have different resources, social and cultural environments, and external factors that influence their competitiveness as tourist destinations. [P18]	√		√		√	
4.	Unorganized [P8, P25, P16]	The difficulties encountered include issues with the management system, monitoring essential services, providing visitor information, and the integration of semi-conventional technology, which is still not fully incorporated. [P8]			√			
5.	Slow adoption [P6]	The use of technology in smart tourism has the potential for broad acceptance, particularly within smart cities. Research indicates that the current adoption of smart tourism in museums is progressing slowly, but there is also significant untapped potential for its utilization. [P6]				√	√	

*T1:EA documentation, T2: EA planning, T3, EA programming, T4: EA Implementation, T5: EA Communication and support, T6: EA governance.

The current state of research on the subject of smart tourism is in its early phase and needs further extensive research. The current body of literature reviews frequently lacks references and a lack of comprehensive analysis of the available data, hence emphasizing the necessity for additional advancements in this domain. Moreover, the substantial financial costs linked to the implementation of Smart Tourism pose a notable obstacle, making it impractical for numerous urban areas. The number of visitors sometimes fails to cover expenses sufficiently, and local governmental entities lack the specialized knowledge necessary to keep up with the swift speed of technological improvements. Smart tourism presents distinct issues for developing countries in contrast with developed economies. Various factors, including the availability of resources, socio-cultural landscapes, and external pressures, significantly influence the competitiveness of tourist locations. Comprehending these unique dynamics is essential for efficiently resolving their particular requirements.

One of the primary obstacles encountered in implementing smart tourism is the lack of structure within the organizational framework. This refers to matters of the management of systems, the monitoring of crucial services, the provision of visitor in-

formation, and the integration of semi-conventional technologies that have not yet been fully included in current frameworks. The adoption of smart tourism technology, particularly in the context of smart cities, has been slow despite its considerable potential for widespread acceptance. The existing body of data suggests gradually adopting smart tourism practices inside museum environments. However, the unexplored potential exists for its more comprehensive application, indicating a viable pathway for additional advancement and incorporation.

2.6.9 Smart Tourism Technology Enablers

This subsection aims to analyze the technological aspects employed in smart tourism based on the studies that have been chosen. Multiple studies have demonstrated the implementation of a web-based portal or the accessibility of a mobile application. Table 2.7 outlines the technologies frequently used in smart tourism, organized based on the architectural layers of ArchiMate, including Applications and Technological Infrastructure.

Table 2.7: Smart Tourism Integration

No.	Layers	Category	Technology
1.	Applications	Portals	- Web-Based [P31, P19, P27, P15, P14] - Mobile Application [P6, P23, P25, P16, P5, P2]
		Messaging format	- MQTT [P6]
		Web service standards	- SOAP [P8] - REST [P14, P11]
		Communication model	- Request-Response [P13, P15] - Publish-Subscribe [P11, P23, P28]
2.	Technological infrastructure	Service Orchestrator	- Services Gateway [P23, P24] - Blockchain [P20] - CADDE (Cross domain) [P21] - Kafka (Message-oriented middleware) [P11, P21]
		Databases	- MySQL [P15] - Cloud infrastructures [P31, P23, P27, P13, P24] - PIP (Platform independent platform) [P25]

Numerous investigations have highlighted the availability of a web-based portal or a mobile application. Table 2.7 provides a breakdown of the technologies commonly utilized in smart tourism. These technologies are classified within the architectural layers of ArchiMate, covering both Applications and Technological Infrastructure. Most of the chosen studies emphasized the adoption of the Message-oriented Middleware. For instance, several authors leveraged the Kafka technology to facilitate the integration of affiliated information systems and the orchestration of services. Apache Kafka is a distributed streaming platform that handles large real-time data volumes.

Additionally, these studies brought attention to fog technology as a messaging format. Fog computing offers a standardized interface that allows for seamless integration of systems into a network. This approach reduces reliance on proprietary and single-vendor solutions, encouraging interoperability among systems and solutions from multiple vendors. The selection of other identified technologies also emerged from these studies. In summary, these findings encompassed the discourse on the types of technologies integrated into a typical smart tourism platform. It is worth noting that while these outcomes gleaned from the selected studies offer valuable insights, they may still exhibit specific gaps when compared to the latest industry implementations, primarily due to the studies' primary focus on enabling business collaborations and the restricted scope within their respective investigations.

2.6.10 SLR Conclusions

In summary, the systematic literature review highlights a noticeable gap in the existing body of research concerning smart tourism within the enterprise architecture domain. While several pieces of literature focus on architecture for some domains of smart tourism, encompassing areas like IoT, hotels, and rural tourism, the generalized architecture to implement smart tourism within the developing country has just been thoroughly investigated in the context of enterprise architecture. Although some limited studies touch upon the architecture in developing countries, including their uniqueness, they are relatively scarce.

Nevertheless, the available research that delves into the domain of smart tourism architecture is IoT. The IoT-enabled Smart Tourism system has several pillars: an Information Exchange Center (IEC), Information accessible devices, Smart Apps, Tourists, and Destinations. Holistically, another architecture aims to address the heterogeneity problem by providing a unifying view in which any tourist item can become part of the integration, which can accommodate any new possible element. However, the author suggests future work to consider the architecture's scalability by studying the adjustment.

Another study underscores the uniqueness of implementing smart tourism in developing countries. They face distinct challenges compared to developed countries because they have different resources, social and cultural environments, and external factors that influence their competitiveness as tourist destinations. This presents an avenue for future investigations to delve into the architecture of smart tourism enterprises within developing countries and formulate reference architecture adjusted to the conditions.

The thesis aims to yield tangible benefits for Enterprise Architecture (EA) and smart tourism, offering valuable insights into creating a reference architecture for the complex tourism industry that needs to be agile. Its distinctive focus lies in research into an aspect of smart tourism enterprise management within developing countries that has received relatively insufficient attention in scholarly inquiry. By examining the uniqueness of developing countries to implement smart tourism, this future work will represent a noteworthy contribution to the academic discourse on enterprise architecture. Beyond its theoretical significance, the proposed thesis offers pragmatic advice for the govern-

ment in the tourism field and all stakeholders in the smart tourism ecosystem. It is a practical resource for professionals seeking to implement this approach within their respective organizations, offering comprehensive insights into introducing the platform into ArchiMate enterprise architecture models.

The study will employ an enterprise architecture model to map the relevant elements to build a reference architecture for smart tourism. By implementing them at the Tourism Department of Pontianak, Indonesia Government, as a case study, this framework will serve as a pilot initiative, demonstrating the introduction of smart tourism reference architecture within the organizations. The Design Science Research Methodology (DSRM) will address the main research question, encompassing three key phases: problem investigation, treatment design, and treatment validation. Given the collaborative nature of the research with LeanIX, a use case from one of LeanIX's prospective clients will be employed. This thesis will be a pilot to introduce LeanIX's product to the Southeast Asian market, especially the Indonesian government. The problem investigation phase will have interviews to discern the current challenges the head of the government faces. The author will also evaluate their current operation. In the treatment design phase, the author will devise deliverables in the form of as-is, migration, target architectures, and LeanIX's workspace. This guidance will also be tailored to be adaptable for other cities in developing countries.

Chapter 3

Smart Tourism Reference Architecture

The previous chapter reported on a Systematic Literature Review to support the identification of a Smart Tourism reference architecture. An analysis is needed to identify and develop the Smart Tourism Platform reference architecture. The first step to designing a reference architecture is to identify the purpose, application context, and timing based on the framework in Chapter 1. Afterward, the steps involve defining the type of the reference architecture, selection of design strategy, empirical acquisition of data, and construction of the reference architecture (Galster & Avgeriou, 2011). Thus, the explorations of the steps mentioned are elaborated based on Type 3 of the reference architecture, as seen in Figure 3.1.

Dimension	Values
G1: Why	Facilitation
↓	↓
C1: Where	Multiple organizations
C2: Who	Independent organization (D), Software organizations (R), User organizations (R)
C3: When	Classical
↓	↓
D1: What	Components, interfaces, policies/guidelines
D2: How	Semi-detailed components and policies/guidelines, Aggregated or semi-detailed interfaces
D3: How	Abstract or semi-concrete elements
D4: How	Semi-formal element specifications

Figure 3.1: Reference Architecture Type 3

3.1 Architecture Goals Definitions

This section aims to answer "Why" this reference architecture needs to be constructed. There are two goals for creating a reference architecture, and they are standardization and facilitation (Angelov et al., 2012). The standardization approach is to achieve interoperability between systems and components. Meanwhile, the facilitation approach aims to offer guidelines for system designers to facilitate the design process of concrete architecture. As described in Figure 3.1, the reference architecture is type three. Therefore, the aim of building the reference architecture is facilitation. Aligned with the type,

this thesis aims to create a baseline for a government in a developing country to build smart tourism ecosystem collaboration in their city.

One of the aspects of realizing smart tourism is the smart tourism ecosystem (STEs). The concept of a smart ecosystem is an interaction between stakeholders at both micro and macro levels, which collaborate to formulate tourism experiences (Bhuiyan et al., 2022). This collaboration includes human organizations, technology, and the mutual exchange of information, services, and resources, all framed within the pre-delivery, delivery, and post-delivery of tourist experiences. The shared goal of implementing STEs is to realize a prosperous, valuable, meaningful, and sustainable tourism experience for tourists using the applications that provide tourism information (Buhalis & Amaranggana, 2013). Afterward, a notion of a platform to support the STEs is supported by Gretzel; the digital environment is a platform that realizes tourism services that connect stakeholders within STEs (Gretzel, Sigala, et al., 2015). Within the ecosystem, there are several parties involved in the process. The categories include touristic customers, residential consumers, tourism suppliers, cross-industry suppliers, government agencies, destination marketing organizations, and intermediaries (Gretzel, Werthner, Koo, & Lamsfus, 2015). As various partners are involved in the activities, the role of the government serves to create a framework and guideline for the construction of STEs (Zhu, Zhang, & Li, 2014). Realizing the right ecosystem based on mutual support and collaboration is essential for developing the system (Koo et al., 2016). Finally, smart tourism can enhance efficiency and improve the brand image and identity of their tourism site to increase competitiveness (Roopchund, 2020).

Based on the systematic literature reviews, stakeholders are experiencing several obstacles to achieving those ideal conditions. Specifically, developing countries face distinct challenges compared to developed because they have different resources, social and cultural environments, and external factors that influence their competitiveness as tourist destinations (Roopchund, 2020). In addition, the other challenges are lack of resources, high cost, lack of resources, disorganization, and slow adoption. Therefore, standardized guidelines for operating a smart tourism ecosystem for developing countries are essential. Finally, the main goal of building the reference architecture in this thesis is to provide a reference architecture for a smart tourism ecosystem collaboration platform to enhance the tourism experience in the context of developing countries.

3.2 Intended Application Context

This part has the goal of answering the "Where," "When," and "Who" of the design of the reference architecture, as mentioned by the literature (Angelov et al., 2012). In the early part of this chapter, the type of the reference architecture is shown in Figure 3.1, which becomes the basis of this elaboration. The "Where" describes the organization's scope, which is impacted by the coarse-grained level of the reference architecture. Afterward, the "Who" is to list the stakeholders that will be the users of the reference architecture. Finally, "When" describes the timing to apply the reference architecture that may impact the goal and design of the reference architecture.

Firstly, the answer to the "Where" question for this reference architecture is multiple organizations. In this sub-dimension, there are two possible values: single organization and multiple organization (Angelov et al., 2012). A single organization is intended only for one type of organization. However, various organizations have several entities that may have a common target market or geographic area. Aligned with the specification, the smart tourism reference architecture is intended for multiple organizations, where the government becomes the facilitator. The government has an essential role in smart tourism system development, which is as a guide and coordinator (Zhu et al., 2014). On a macro scale, the government should implement clear guidelines to implement smart tourism nationally, not only promoting the development through policies and regulations. Conversely, at the micro level, the government should guide local businesses to combine technology into the business process within smart tourism.

Secondly, the answers to "Who" questions for this reference architecture are independent organization, software organization, and user organization. In the case of multiple organizations, several stakeholders may involved in the reference architecture (Angelov et al., 2012). Software organization is the role that designs and applies the reference architecture; user organization is the user of the software created based on the architecture designed, and independent organization is the one who does not implement the solution based on the architecture. The stakeholders in the category of an independent organization are the educational institution and me as the researcher. Afterward, the software organization is the smart city team within the government. Eventually, the user organizations are the stakeholders within the smart tourism ecosystem.

Lastly, classical is the answer to "When" questions for this reference architecture. There are two possible answers to this question they are preliminary and classical reference architecture (Angelov et al., 2012). A preliminary reference architecture is a reference architecture that designs the interconnection between layers in the enterprise architecture that have not yet been implemented in the practices. However, classical reference architecture is a reference architecture of a practice that is ongoing in the field at the time of the design process of the reference architecture. Therefore, since the smart tourism ecosystem is operating, it is a classic. Several stakeholders within the smart tourism ecosystem have been executing their tourism experience to improve and deliver the best tourism experience.

3.3 Architecture Requirement Analysis

This section aims to answer the "What" and "How" of the reference architecture. The elaboration of the type of information, detail, abstraction, and formality of the reference architecture is described here. As this reference architecture is type 3, it includes components, interfaces, and policies as the lists of the elements defined in the reference architecture. Afterward, the reference architecture is designed semi-detailed. Semi-detailed architecture is the intersection between detailed architecture, which has more than one aggregation, and aggregated architecture, which has one aggregation (Angelov et al., 2012).

Furthermore, this reference architecture is at the abstract level. The abstract is designed to define the architectural element, leaving an open space to explore the option. Finally, the formalization of the architecture is semi-formal; a well-defined notation with semantics represents the reference architecture. That is why the element of the architecture will be visually represented through a well-known modeling language in Enterprise Architecture Management, which is ArchiMate.

As this chapter dives into treatment design, requirements need to be specified (Wieringa, 2014). It is essential to collect the relevant requirements for a smart tourism ecosystem platform (Nakagawa et al., 2014). There are several ways to gather information, such as people, software systems, publications, reference models, and domain ontologies. Furthermore, the requirements for this reference architecture are gathered through a systematic literature review, documents, and people through interviews. Therefore, the result of this section will be visualized as ArchiMate's viewpoint in the design synthesis section.

Firstly, facilitating the digitalization of the smart tourism business process is one of the topics that the literature heavily discusses, and it has become part of the architectural requirement in this reference architecture. To support the architecture requirement, specifying the software requirements is needed (Nakagawa et al., 2014). Smart tourism should give access to the stakeholders and consumers to technology in the tourism business process (Vecchio, Mele, Ndou, & Secundo, 2018). The smart tourism platform's ability to integrate tourism information and services from several parties (Sabbioni, Villano, & Corradi, 2022), with digital monitoring features (Qin & Pan, 2023), decision-making function (Lv, 2022), automated processes (Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015b), gamification (Rouhani et al., 2015b), big data (Roopchund, 2020), and forecast the tourism demand (Vecchio et al., 2018) should be realized in the platform.

Secondly, the architectural requirement drawn by current works of literature is to facilitate the marketing of tourism sites. It is supported by state-of-art and official documents of smart city master plans in developing countries. Smart tourism believes it will improve the government's positioning, creating a compelling government image (kuanrong & guili, 2017). Furthermore, it is supported by the goal of the smart city plan by Pontianak City, Indonesia, which is to "Improve the brand value of Pontianak City to encourage local economy uniqueness" (Mayor of Pontianak City, 2019). Furthermore, it is supported by the goal of the smart city plan by Pontianak City, Indonesia, which is to "Improve the brand value of Pontianak City to encourage local economy uniqueness" (Mayor of Pontianak City, 2019). Therefore, the software requirements are constructed as follows. The platform suggested giving access to the government and stakeholders to increase the online reputation of their tourism (Tsai et al., 2018). Also, it provides access for stakeholders in the domain to cross-marketing (Antonio, Correia, & Ribeiro, 2020).

Thirdly, enabling intelligent infrastructure at the tourism site is the following architectural requirements. The following statements are building blocks for system requirements. Initially, the government's access to intelligent infrastructure on the tourism site should be realized (Roopchund, 2020). In addition, the platform's ability to incorporate IoT technologies in the operations (Sharma, Rishi, & Sharma, 2020) and transform

real-time data as insight is essential (Vecchio et al., 2018). The following architectural requirement is to provide access to the standardized guidelines for the collaborations of the smart tourism ecosystem. It is constructed by several requirements, which include providing access to the government to the standardized framework (Roopchund, 2020), guidelines (Qin & Pan, 2023) and tracking compliance with the standard (Huang et al., 2012) for a proper smart tourism ecosystem (Vecchio et al., 2018).

Lastly, support for the stakeholders to operate smart tourism effectively becomes the architectural requirement. The supporting evidence is that the literature describes that the innovative tourism platform should be able to have smart governance in its operations (Roopchund, 2020). Furthermore, it should support access for local businesses from the government to start their business (Pereira et al., 2015), reduce the cost of their tourism business activities (Angelaccio, Basili, & Buttarazzi, 2013), and have cost-saving policies (Kansakar, Munir, & Shabani, 2018) as the software requirements. Finally, the software requirements, architecture requirements, and the ArchiMate viewpoint that illustrates them are shown in Figure 3.1.

Table 3.1: Architecture Requirement Analysis

No.	System Requirement	Architecture Requirement	ArchiMate Viewpoint
1.	Access for the stakeholders and consumers to technology in the tourism business process	Facilitate digitalisation of smart tourism business process	Smart Tourism Application Usage Viewpoint
2.	The ability of the platform to integrate tourism information and services from several parties		
3.	The ability of the application to have digital monitoring features		
4.	The ability of the platform to provide a decision-making function for the management		
5.	The ability of the platform to execute automated processes		
6.	The ability for the consumers to have gamification in the platform		
7.	The ability of the application to access open and big data in the process		
8.	The ability of the application to forecast the tourism demand		
9.	Access for the government and stakeholders to increase the online reputation of their tourism	Facilitate marketing of tourism site	Marketing Business Process Cooperation Viewpoint
10.	Access for stakeholders in the domain to do cross-marketing		
11.	Access for the government to have intelligent infrastructure on the tourism site	Enable intelligent infrastructure at the tourism site	IoT Technology Usage Viewpoint
12.	The ability of the platform to transform real-time data as an insight		
13.	The ability of the application to incorporate IoT technologies in the operations		
14.	Access for the government to the standardised framework of smart tourism	Provide access to the standardised guidelines for the collaborations of the smart tourism ecosystem	Smart Tourism Service Realization Viewpoint
15.	Access for the government of smart tourism guideline		
16.	Access for the government to track compliance with the standard in the smart tourism process		
17.	Access for the stakeholders to the proper smart tourism ecosystem		
18.	Access for stakeholders to do co-creation process for their tourism product		
19.	Access for the stakeholder's cooperation in tourism activities facilitated by the government		
20.	Access for stakeholders to improve the employee's skills	Support for the stakeholders to operate smart tourism effectively	Smart Tourism Strategy Viewpoint
21.	Access for local businesses the support from the government to start their business		
22.	Access for the stakeholders to reduce the cost of their tourism business activities		
23.	The ability of the government to have smart governance in its operations		
24.	Access for the government to have cost-saving policies.		

3.4 Architecture Design Synthesis

Throughout the architecture requirement analysis, the results are a list of architecture and software requirements for the smart tourism reference architecture. Thus, the architecture requirements are categorized into ArchiMate modeling language with the viewpoint shown in Figure 3.1. The reference architecture presented in this study employs ArchiMate. It is widely recognized modeling language has demonstrated its effectiveness in enterprise architecture design, as demonstrated in several empirical case studies (Lankhorst, 2017). The viewpoint covers relevant aspects of the ArchiMate elements and their connections as representations visualized in different diagrams (Open Group, 2021). We present the viewpoints of our reference architecture in this section, clustered into four groups that show the scope that the viewpoints cover (Open Group, 2021). Firstly, the composition category includes viewpoints that describe internal elements of the component, for instance, the smart tourism organization viewpoint. Secondly, the support category includes viewpoints that illustrate the support of one layer to another layer; in this project, the viewpoints are the viewpoints on smart tourism application usage and IoT technology usage. Thirdly, the cooperation viewpoint includes integrating elements across different aspects; an example is smart tourism marketing business cooperation. Finally, the realization viewpoint shows how one element realizes another aspect; in this project, the smart tourism service realization viewpoint is the instance. Therefore, the proposed reference architecture is described through those viewpoints.

The reference architecture employed is a classical facilitation architecture developed for several organizations by an independent organization (Angelov et al., 2012). The independent organization may be in the form of different organizations. Furthermore, in this research, the independent organization is the government of Indonesia that manages smart tourism initiatives. Therefore, they have the capacities and resources to create the reference architecture to standardize the process because of the capacities and resources they own. This section aims to develop a reference architecture for smart tourism derived from the insights gathered from the systematic literature review and expert interviews. The reference architecture type 3 is implemented semi-abstractly to visualize how concrete the architecture is. Thus, semi-abstract architecture identifies a distinct class of possibilities for each architectural component and leaves the freedom to create a choice for a specific element (Angelov et al., 2012). The motivation of the stakeholders is illustrated in the following section, which serves as the foundation for creating a smart tourism platform reference architecture.

3.4.1 Smart Tourism Motivation Viewpoint

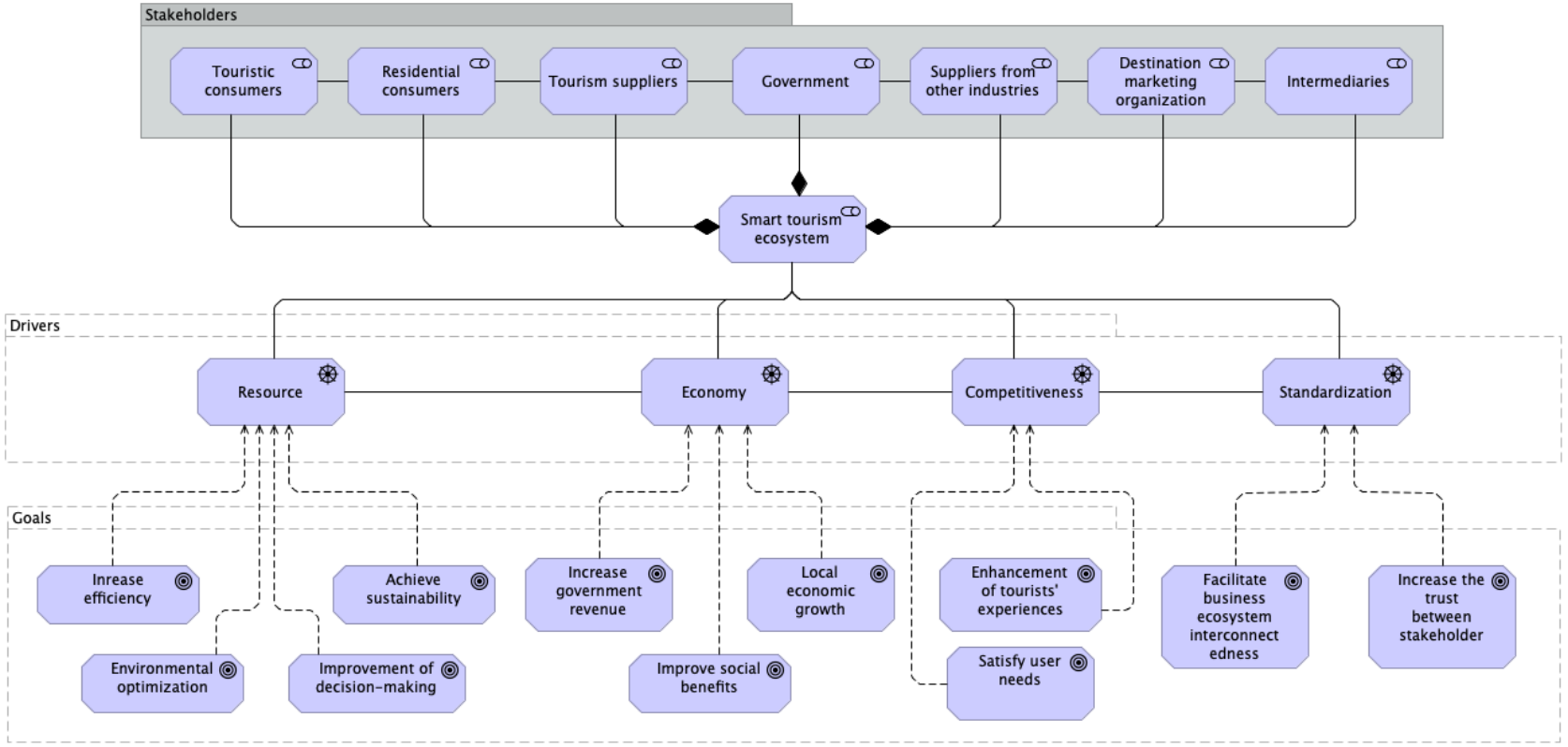

Figure 3.2: Motivation Layer of Reference Architecture

Based on the prior sections' observations and analysis, the motivation of the reference architecture offered in Figure 3.2 is proposed as the result of this research. The architectural design is influenced by the findings of the previous sections, explicitly focusing on the first research question related to motivations. The analysis presented in Table 2.5 identified three key drivers that motivate organizations to embark on smart tourism initiatives: "Resource," "Economy," "Competitiveness," and "Standardization." The success of these drivers is dependent on a set of objectives. Additionally, Table 2.5 outlines the necessary conditions for achieving these objectives. However, they are not visibly displayed in the proposed reference design to preserve the model's clarity.

The stakeholders specified in the proposed reference architecture are derived from the smart tourism ecosystem as conceptualized by Gretzel. A smart tourism ecosystem can be described as a collaborative environment that is assisted by a digital ecosystem and consists of several participant groups. The categories include touristic customers, residential consumers, tourism suppliers, cross-industry suppliers, government agencies, destination marketing organizations, and intermediaries (Gretzel, Werthner, et al., 2015). Thus, creating a cohesive reference architecture for smart tourism can be achieved by identifying the stakeholders with the motivation and aim.

3.4.2 Smart Tourism Strategy Viewpoint

The motivation viewpoint in Figure 3.2 describes the stakeholders' underlying reasons for initiating smart tourism initiatives. The viewpoint is based on the motivation and challenges listed in the Challenge of Smart Tourism in Table 2.6. Regardless of the challenges faced by the stakeholders listed in Table 2.6, a strategy to realize smart tourism is essential. Accordingly, a strategy viewpoint is able to illustrate the strategy necessary for smart tourism. The strategy viewpoint describes a high-level enterprise's strategies, which include capabilities and outcomes (Open Group, 2021). Therefore, an illustration of the strategy to have proper smart tourism is necessary. Smart tourism strategy viewpoint can be seen in Figure 3.3.

As illustrated in the Figure below, the strategy is mapped accordingly from the motivation findings in Figure 3.3. Afterwards, the motivation is analyzed through the requirement analysis from Table 3.1. Several capabilities are needed to achieve the outcomes of smart tourism. The stakeholders must ensure the personnel have digital literacy, local business management skills, and good cost-saving policies. One element acts as the central course of action: having the government as a guide that realizes standardized guidelines for smart tourism.

Consequently, those capabilities will realize the goals of the growth of the local business, reduced cost of tourism activities, improvement of tourism personnel, and standardized guidelines for smart tourism. Finally, all of the goals visualized will contribute to achieving tourism competitiveness based on the findings from the research.

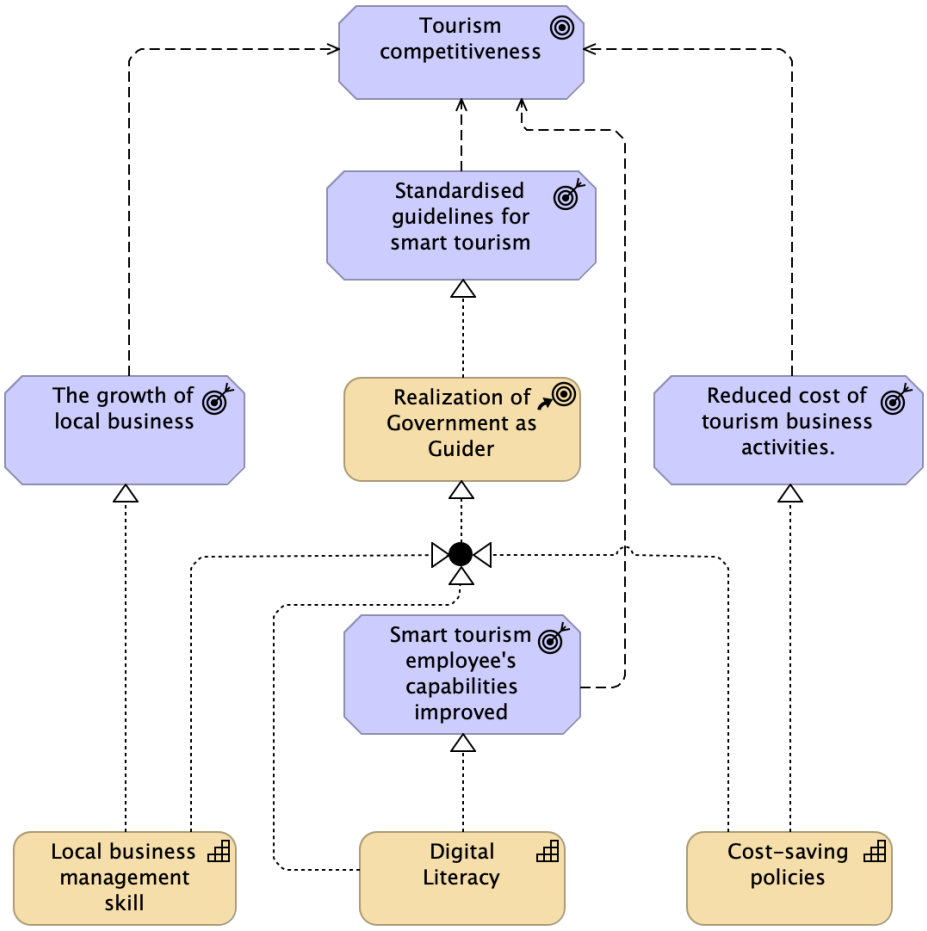

Figure 3.3: Smart Tourism Strategy Viewpoint

3.4.3 Smart Tourism Total Viewpoint

ArchiMate total viewpoints or basic viewpoints include three main ArchiMate layers: business, application, and technology. The viewpoints are extended to several viewpoints to address the specific stakeholder concern. Based on the prior sections' observations and analysis, the reference architecture offered in Figure 3.4 is proposed as the result of this research.

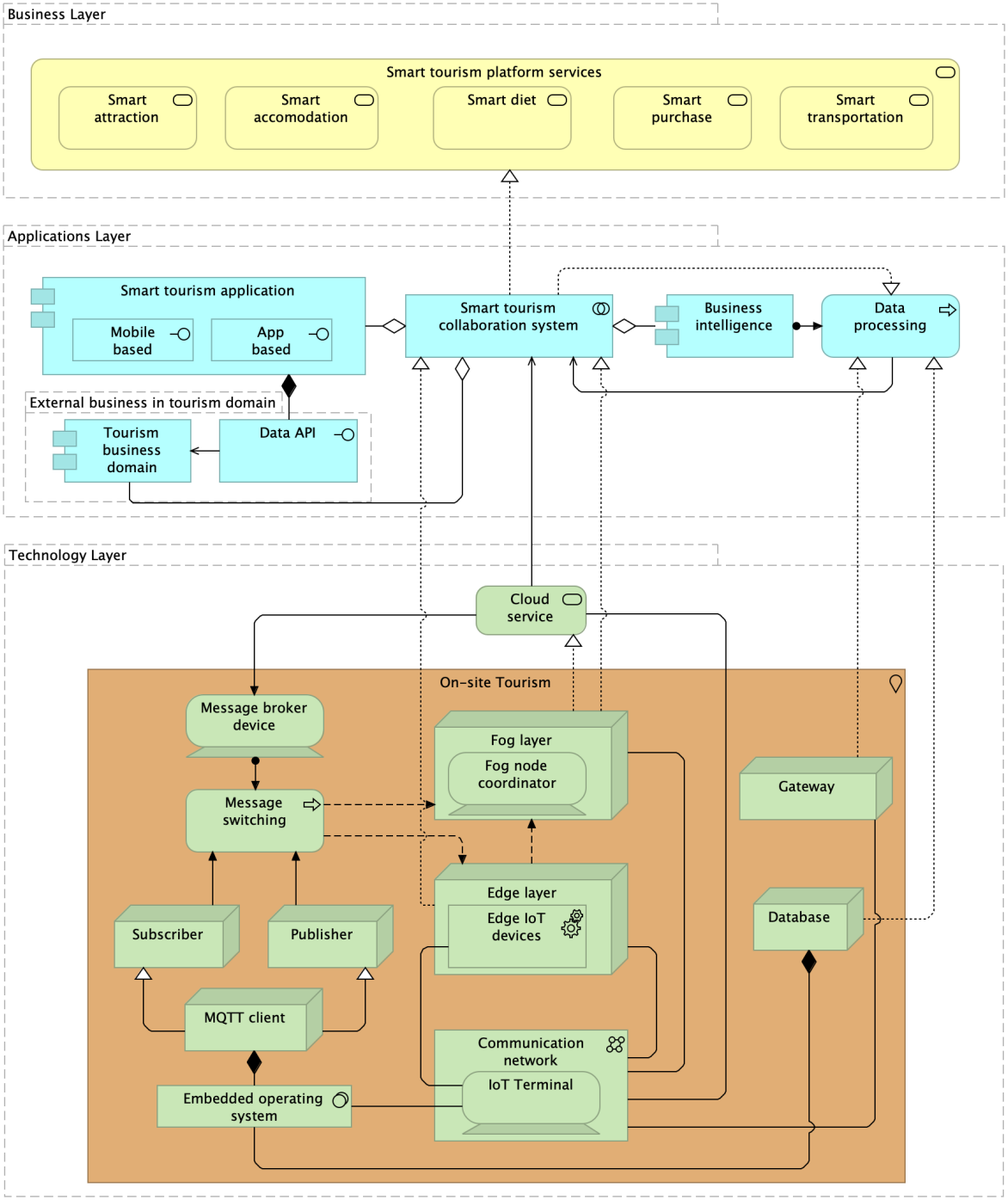

Figure 3.4: Smart Tourism Platform Reference Architecture Total Viewpoint

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Business Layer

The Business Layer constitutes the second layer of this architecture and comprises Smart Attraction, Smart Transportation, Smart Accomodation, Smart Diet, and Smart Purchase. These functions are derived from the analysis of smart tourism service platform (Chuang, 2023). Based on the study, the Smart Attraction service leverages digital technology to integrate the attraction and stakeholders using smart tourism platforms (Wang, Li, Zhen, & Zhang, 2016). Afterward, tourism relies on the mobility of the tourists, which is realized by Smart Transportation services, which feature location-based applications and navigation (Gonzalez, Ferro, & Liberona, 2020). Besides that, the Smart Accommodation service integrates digital technologies like accommodation information and booking according to the needs (Buhalis & Leung, 2018). The following service is Smart Diet, Incorporating ICT into culinary access such as information and ordering services (Okumus, Ali, Bilgihan, & Ozturk, 2018). Equally vital is the Smart Purchase service, an integral component of the economic development strategy in the tourism field, which includes a system of establishments of an e-commerce platform to acquire and purchase tourism products comfortably (Buhalis & Amaranggana, 2014).

Application Layer

The Application Layer aids the Business Layer with application services implemented through application components (Lankhorst, 2017). However, due to the type of the reference architecture mentioned, which is semi-abstract. The application will generally serve the whole business function. The specific correlation between application and business will be explored further in the following Chapter to maintain the abstraction.

The Application Layer encompasses Application Components, Application Services, and Application Collaboration constructs in this reference architecture. While real-world implementations of these elements vary, common concepts from selected studies have been outlined in Table 2.7 and are visible in this architecture. Examples include providing a Smart tourism collaboration system and integrating with existing applications through the smart tourism application, utilizing Web Services technology. In addition, a data processing application function accommodates big data acquisition from the IoT and other devices; this function is assigned to the Business Intelligence application. Decisions about messaging formats and web-service standards for application communication generally depend on current industry trends or technical requisites. They are independent of the choice to align with smart tourism.

Technology Layer

The Technology Layer serves as the foundation for the third layer, providing essential infrastructure services such as processing, storage, communication, and system software necessary for executing applications (Lankhorst, 2017). The common aspects underpinning collaboration platforms in typical smart technology projects primarily involve providing a cloud service to facilitate the fog layer, edge layer, and the Internet of

Things (IoT) devices widely employed in the sector. In addition to the technology, supplementary components are involved, such as deploying Database Management Systems, Message-Oriented Middleware, MQTT, and Gateway.

The technological layer depicted in Figure 3.4 is structured into three distinct layers: cloud, fog, and edge. The Cloud Services technology component handles extensive data processing and storage requirements. This component is intricately linked to a Message Broker, a critical element in managing interactions between various systems and cloud components. The Message Broker ensures secure and efficient data transfer among application components. For message-switching functions, the MQTT protocol is employed. Recognized for its suitability in IoT contexts, MQTT is the preferred protocol for connecting devices to the cloud, utilizing a publisher/subscriber model to facilitate connections between different entities (Mijuskovic, Bemthuis, Aldea, & Havinga, 2020).

3.4.4 Smart Tourism Organizations Viewpoint

The total viewpoint illustrated in Figure 3.4 mentions a glimpse of the stakeholders involved in the smart tourism project. Due to the complex parties in smart tourism, it is essential to describe the stakeholder relations to realize a collaboration. Therefore, a viewpoint on smart tourism organizations is proposed in this research. The organization viewpoint emphasizes how the organization of a company, a department, a network of companies, or another type of organization operationalizes within the system (Open Group, 2021). This viewpoint is beneficial to allocating competencies, hierarchy, and responsibilities within the organization. Therefore, it is essential to describe the organizational viewpoint to visualize the complex stakeholders often defined as a smart tourism ecosystem. A smart tourism ecosystem is a system that creates, manages, and delivers tourism services using technology directed to information sharing and value creation (Gretzel, Sigala, et al., 2015).

Furthermore, smart tourism ecosystems are supposed to be a dynamic network (Murphy, Pritchard, & Smith, 2000). The stakeholders within the ecosystem are service providers and consumers, support services, technologies, NGOs, and suppliers from other industries (Gretzel, Sigala, et al., 2015). In addition, the categories include touristic customers, residential consumers, tourism suppliers, cross-industry suppliers, government agencies, destination marketing organizations, and intermediaries (Gretzel, Werthner, et al., 2015). The main stakeholders of the smart tourism ecosystem are the government, destination management organizations, tourism suppliers, suppliers from other industries, tourist consumers, residential consumers, and intermediaries. The role of the guider and resource allocator for the smart tourism ecosystem is the government (Zhu et al., 2014). They have an important role in smart tourism because they set guidelines and implement policies and regulations (Roopchund, 2020). As a result, the government produces a smart tourism infrastructure through mobile and web applications that realize smart tourism services collectively maintained by the smart tourism ecosystem. It is supported through data collection and data monitoring by the smart tourism ecosystem whether they are located on-site tourism or outside (Zhu et al., 2014). Finally, the relationship among them is shown in the viewpoint through Figure 3.5.

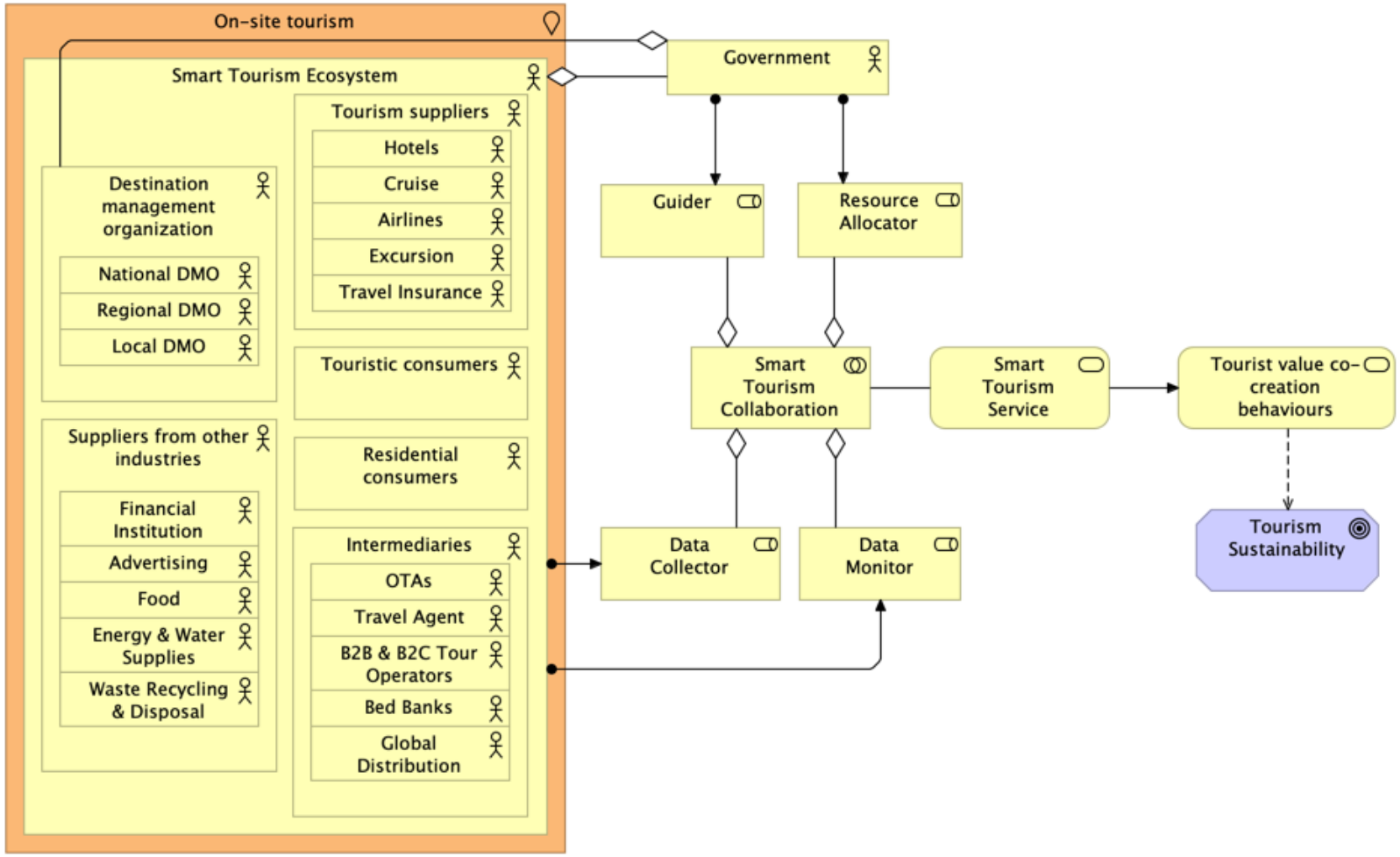

Figure 3.5: Smart Tourism Organizations Viewpoint
(Stakeholders elements are derived from the Motivation Viewpoint in Figure 3.2).

It is essential to map the stakeholders according to the architecture to create cohesive smart tourism. The stakeholders need to follow the guidelines by the government that lead to tourist value co-creation behaviors (Chuang, 2023). The arrangement of value co-creation between tourists and stakeholders based on touristic activity with the smart tourism application (Edeh, Zayed, Perevozova, Kryshtal, & Nitsenko, 2022). Finally, that behavior will collectively realize the goal of achieving tourism sustainability for each tourist spot.

3.4.5 Smart Tourism Service Realization Viewpoint

In the ArchiMate total viewpoint illustrated in Figure 3.4, smart tourism services are visualized generally, which are smart attraction, smart accommodation, smart diet, smart purchase, and smart transportation. However, it does not explain how the services are realized in smart tourism initiatives. It is necessary to understand how the stakeholders can learn smart tourism services. Therefore, the service realization viewpoint can be the solution to solve the problem. The service realization viewpoint describes one or more business services achieved through the business process or application components (Open Group, 2021). It helps support the view from outside of a business process. Thus, it helps elaborate the business process that supports the smart tourism service.

Furthermore, as illustrated by the figure of smart tourism service realization below, several sub-sections of the services are under Smart Tourism. Smart tourism services include smart attractions, smart accommodation, smart diet, smart purchases, and smart transportation (Chuang, 2023). Based on Chuang, the smart attraction includes providing smart attraction access. Smart accommodation involves providing smart accommodation access. The smart diet includes providing smart culinary access. The smart purchase involves providing smart payment access. Finally, smart transportation includes providing smart transportation access in tourism spots.

Those services are assigned to the government as smart tourism providers and other stakeholders as external tourism providers. The government collectively gathered the data through smart applications, on-site IoT devices, and integrating external tourist-operated applications. Therefore, planned coordination can effectively realize real-time data smart tourism services to tourists. The viewpoint is illustrated in Figure 3.6.

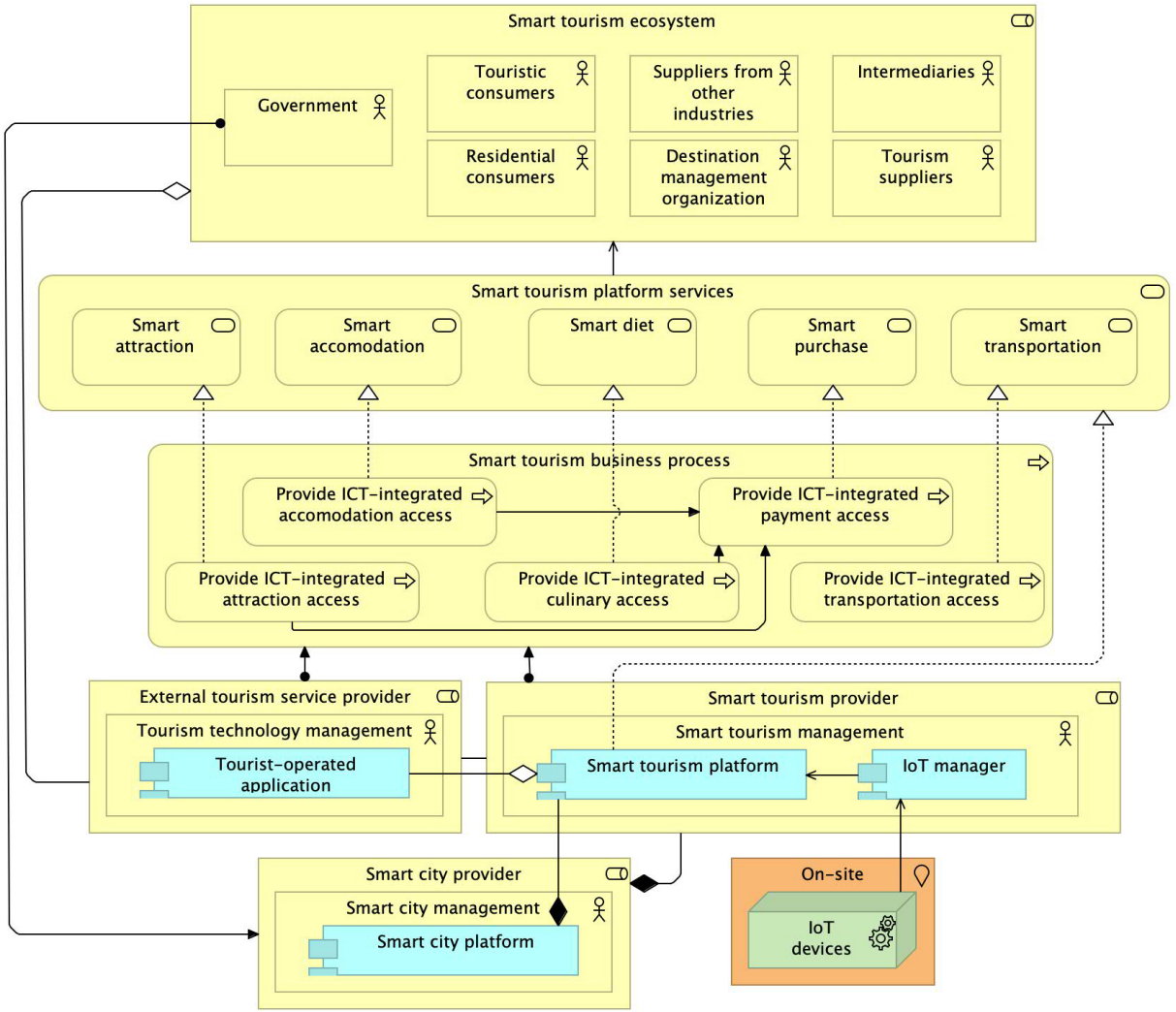

Figure 3.6: Smart Tourism Service Realization Viewpoint
(Services, stakeholders, and applications elements are derived from the Total Viewpoint in Figure 3.4).

3.4.6 Smart Tourism Application Usage Viewpoint

Figure 3.4 illustrates the application layer in the total viewpoint. That section shows the relationships between each application to realize a smart tourism collaboration system. However, it does not describe how each application supports the business process and how they integrate. Therefore, the application usage viewpoint is utilized to define the relationship mentioned. The application usage viewpoint explains how applications are used to support the business and how the applications communicate with each other (Open Group, 2021). This viewpoint helps the architect design an application crucial for the business process. Therefore, this viewpoint is helpful to map the suitable smart tourism application related to the smart tourism business process. Figure 3.7 illustrates the application usage viewpoint.

As shown in Figure 3.7, it integrates the smart tourism application and external tourism service application that support each other. The part of the visualization below is also inspired by research that has been conducted to create a reference architecture for a Service-Oriented Business Collaboration for a Rural Business Ecosystem, especially in Indonesia (Firdausy, 2021). The visualization portrayed in that research is able to visualize developing countries' situations sufficiently, which can be a good foundation for building a reference architecture for smart tourism in developing countries.

Smart tourism platforms are realized after the business intelligence application processes real-time IoT data using the smart city and tourism platform infrastructure. The IoT data includes temperature, humidity, traffic, occupancy, water, and air quality. Afterward, the application consists of the application interface for each smart tourism service, such as attraction, accommodation, culinary, transportation, and transaction. Thus, the interface allows users to access smart tourism services that the government facilitates. External tourism platforms support the smart tourism platform well to enrich the tourist experience. The application realizes application functions such as airline management, excursion management, and other companies inside the smart tourism ecosystem. It is connected by API and web service to integrate each application's data into one another. The integration cloud service infrastructure supports data integration, which uses message-based communication. The cloud also supports the IoT management platform to provide and consume data for the smart tourism application.

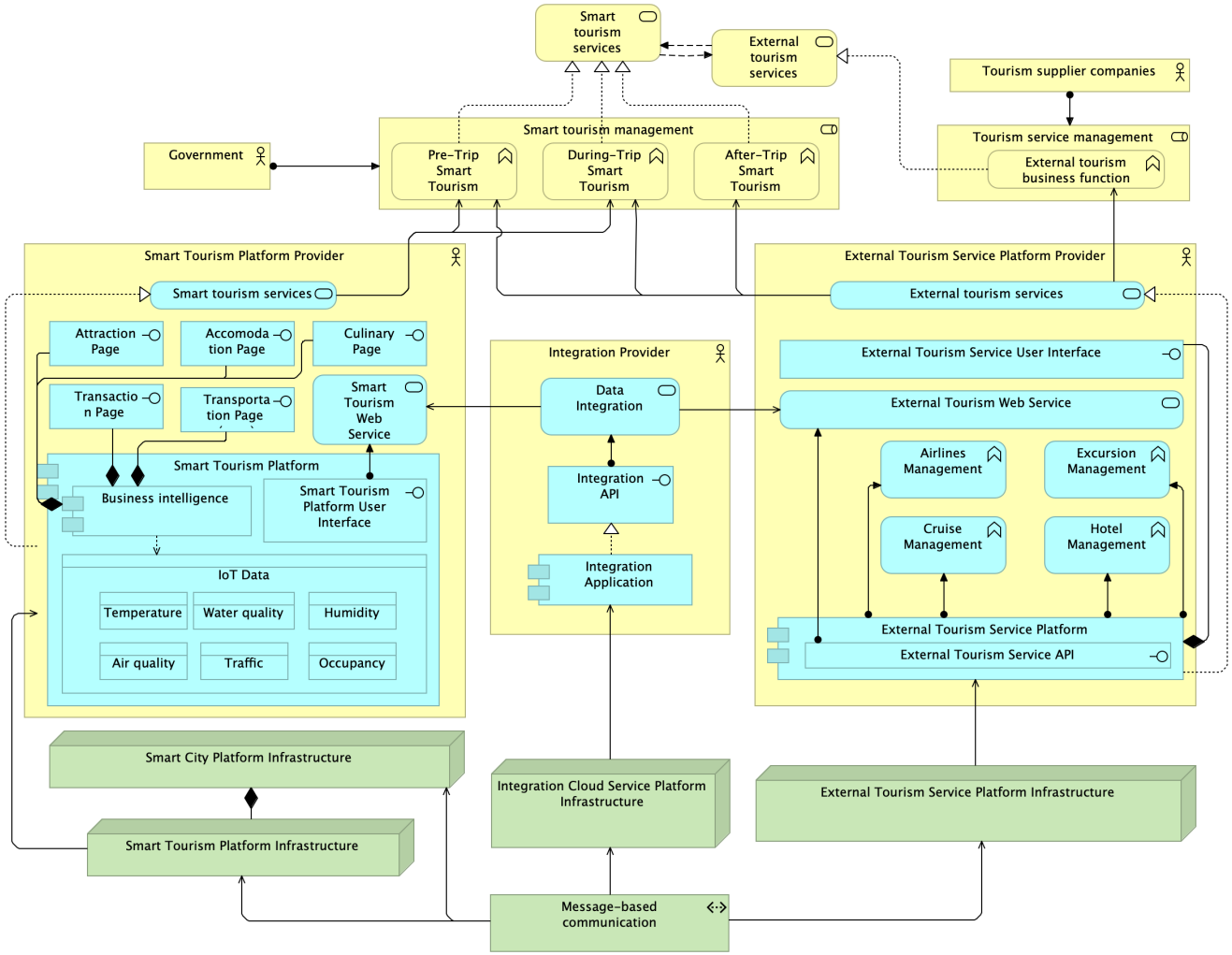

Figure 3.7: Smart Tourism Application Usage Viewpoint
(Applications elements are derived from the Total Viewpoint in Figure 3.4, and stakeholders are derived from the Motivation Viewpoint in Figure 3.2).

3.4.7 Marketing Business Process Cooperation Viewpoint

Previous viewpoints that have been defined in the past sections visualize the business services of smart tourism, such as in Figure 3.6. Another viewpoint is needed to specify the tourist business process in the tourism industry and how each organization relates to each tourism activity process. Therefore, a business process cooperation viewpoint is enforced to achieve the goal discussed.

The business process cooperation viewpoint describes how the business process in the environment is connected to each other (Open Group, 2021). Providing high-level design to the operational manager to see dependencies between processes is advantageous. Therefore, this viewpoint is suitable to illustrate the goal of increasing tourism competitiveness as mentioned in Table 3.2. Marketing for each tourism spot is inevitable to increase competitiveness. Sustainable value co-creation comes from collective behavior from all of the stakeholders inside the smart tourism ecosystems and consists of three phases of travel: pre-, during, and post-trips (Xiang, Wang, O'Leary, & Fesenmaier, 2014). As shown in Figure 3.8.

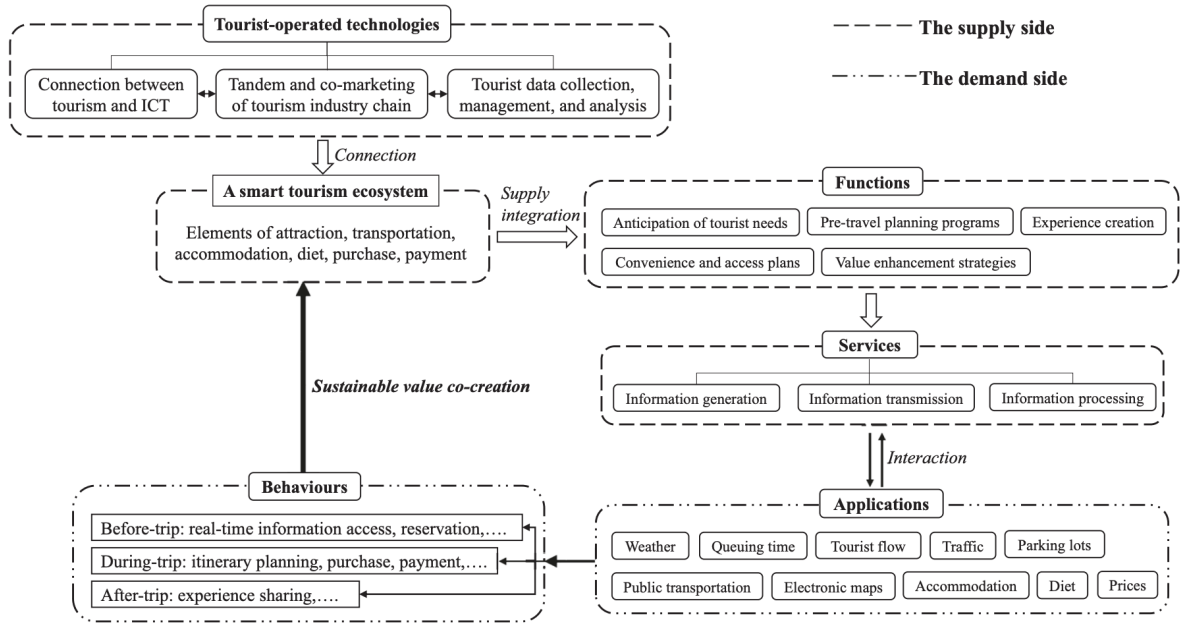

Figure 3.8: Framework of Smart Tourism Platform
(Chuang, 2023)

The framework of smart tourism strategies aids in understanding the flow of smart tourism processes. Additionally, it serves as the foundation of tourist activities in the industry. However, the explanation of stakeholder's influence and the service they provide to each tourism phase still needs to be defined clearly. Therefore, the coordination of marketing activity between the stakeholders based on the travel phases is visualized in Figure 3.9.

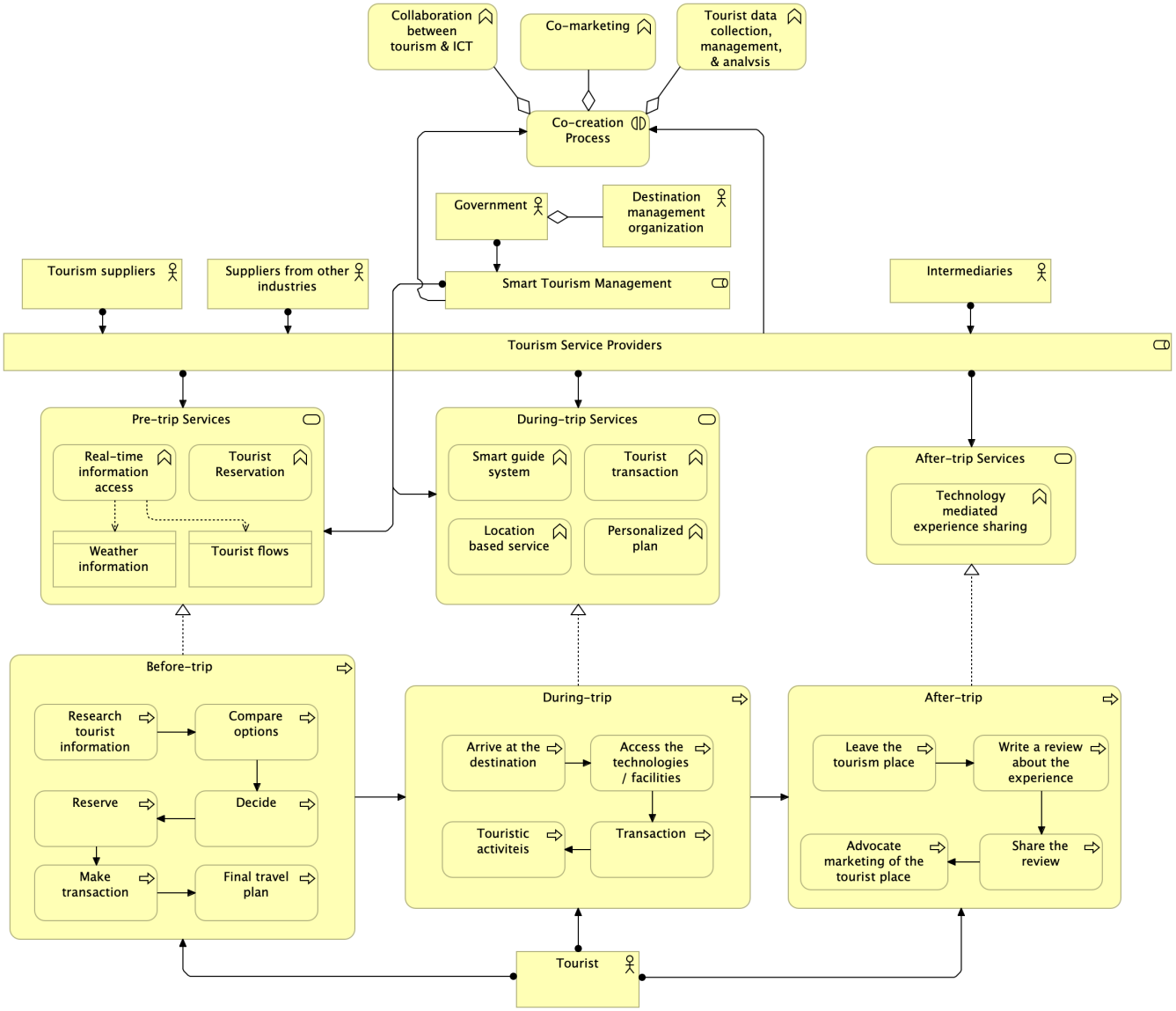

Figure 3.9: Marketing Business Process Cooperation Viewpoint
(Stakeholders elements are derived from the Motivation Viewpoint in Figure 3.2).

As elaborated in Figure 3.9 above, the before-trip consists of a process for tourists to research, decide, and purchase travel options. That process is supported by before-trip services, which include real-time information access and tourist reservations provided by tourism companies. The during-trip consists of all activities that tourists do at the tourism spot, supported mainly by smart tourism services such as smart guides, location-based services, and personalized plans facilitated by the government. Lastly, after-trip activities heavily involve the review from the tourist. External tourism companies support this process through technology-mediated experience sharing. Thus, if coordinated well, all of the processes will realize the co-creation process that includes technology collaboration, tourist data collection, and co-marketing, which relates to the goal of smart tourism.

3.4.8 IoT Technology Usage Viewpoint

The smart tourism application usage viewpoint in Figure 3.10 describes each application involved in smart tourism initiatives. Through that viewpoint, an application that involves IoT data is mentioned briefly. Nevertheless, an overview of how the IoT technology supports the application has yet to be defined. Despite that, IoT plays a massive role in smart tourism activities. Therefore, the illustration of how the IoT technology supports the application is exposed through the viewpoint of technology usage.

The technology usage viewpoint visualizes how the software and hardware technology support the application (Open Group, 2021). The viewpoint is beneficial to determine the quality of the infrastructure that supports the application. Since smart tourism relies on IoT technology, this viewpoint is suitable to illustrate the relationship between the technologies. The technology architecture illustrated comprises three primary layers: cloud, fog, and edge. This structure's core is the Cloud Services technology component, which manages data processing and storage. This component is closely integrated with a Message Broker, an essential tool for orchestrating communication between various systems and cloud-based components. The Message Broker is key in ensuring that data is transmitted securely and efficiently across application components. In terms of message-switching functions, the architecture utilizes the MQTT protocol. As shown in Figure 3.10 of IoT technology usage viewpoint below, the cloud service bridges the application and technology. The cloud service is realized through fog and edge layers to minimize the latency of IoT data. The communication network and message broker control the communication between the technologies. The MQTT client's method of communication is subscriber and publisher.

Situated between the cloud and edge layers, the fog layer component plays a crucial intermediary role in data handling. Data collected at the edge layer is first sent to the fog layer, where fog nodes are responsible for data processing. In instances where these fog nodes become overwhelmed with data, the cloud layer steps in to manage a portion of the data processing and storage workload. This data, collected via IoT devices, is pivotal in maintaining the application's decision-management capabilities. The closeness of the fog layer to edge devices is strategically leveraged to enable rapid data processing, thereby enhancing latency.

Moreover, the IoT Terminal facilitates database technology processing, further contributing to the system's efficiency. Thus, the data flows to the data processing process to generate information in the smart tourism application, including the external tourism service provider. The smart tourism application has an internal application to manage the dashboard and generate internal data reports. Thus, the public application is the platform for the public to gain valuable information for their touristic experiences. Finally, smart tourism applications are part of smart city applications.

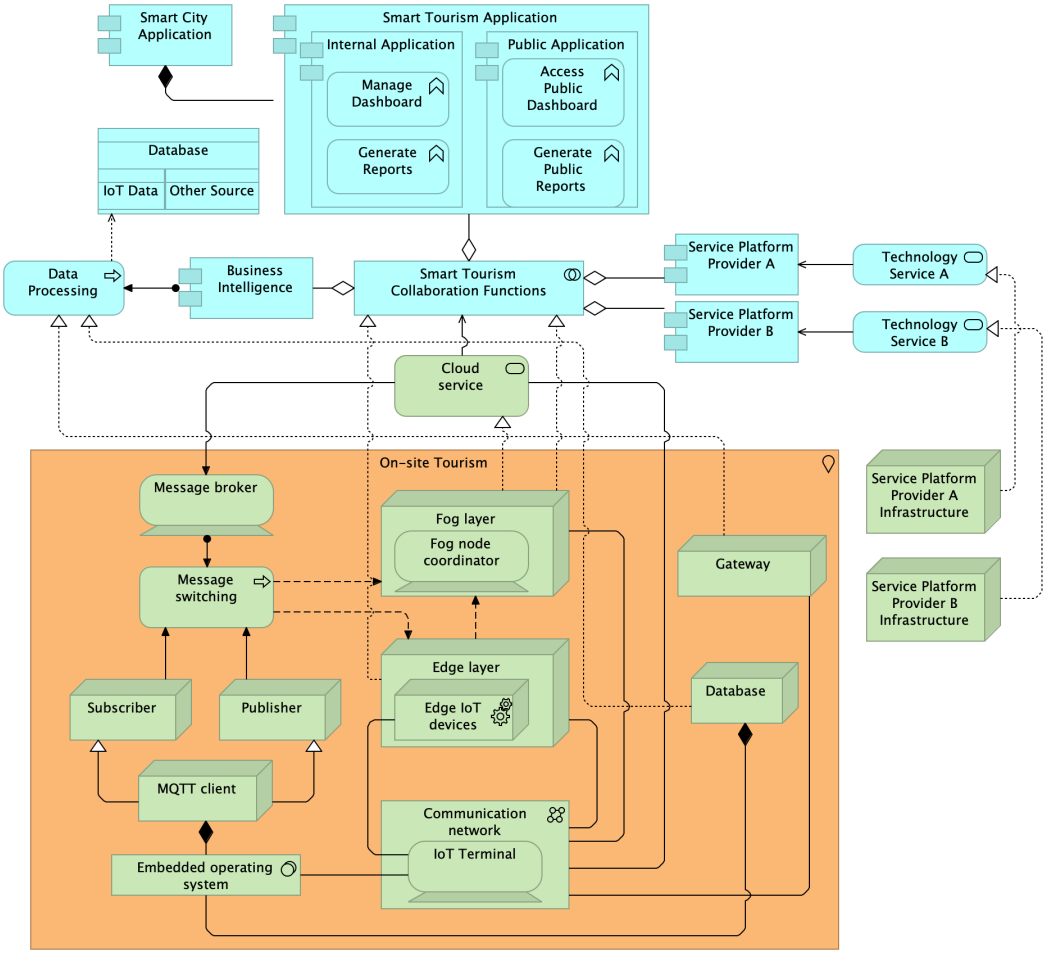

Figure 3.10: IoT Technology Usage Viewpoint
(Technologies and applications elements are derived from the Total Viewpoint in Figure 3.4).

Chapter 4

Solution Architecture for Pontianak Smart Tourism

Within this chapter, the solution architecture for Pontianak smart tourism is based on the proposed reference architecture in Chapter 3.

The project implements the instantiation by utilizing the reference architecture in a real smart city initiative. The project is tailored to Pontianak City, West Borneo Province, Indonesia Smart City initiative. Therefore, an instantiation aligned with the case study's current condition must be realized to implement the reference architecture to the project. The solution architecture will be modeled in ArchiMate as the modeling language and LeanIX's software as the enterprise architecture management tool. With LeanIX's tool, the government can gain real-time insight into the enterprise architecture landscape and adaptively through smart tourism business transformation. Afterward, the ArchiMate and the LeanIX meta-models will be aligned to study their correlation. Finally, the solution architecture will represent the proposed architecture in Chapter 3 to be validated by the stakeholders in the Pontianak City, West Borneo Province, Indonesia Smart City Initiative.

4.1 Pontianak Smart City Initiative

The current concept of smart city development is undoubtedly one solution for the government to manage its city effectively and efficiently. Through this approach, the performance of development and implementation of government and public services will become increasingly excellent. Pontianak City was chosen to join the Movement Realizing 100 Smart Cities (districts/cities) in Indonesia, which was initiated by the Ministry of Communication and Information and supported by the Ministry of Domestic Affairs (Mayor of Pontianak City, 2019).

The National Development Planning Agency, the Ministry of Public Works and Public Housing, the Ministry of Cooperatives, and the Presidential Staff Office have brought the consequence of immediately preparing a plan document which will later become a common reference for all stakeholders involved in implementing the development of the Pontianak Smart City. The Pontianak Smart City project logo can be seen in Figure 4.1.

Figure 4.1: Pontianak Smart City Logo

4.1.1 Site Observations and Interviews

For my thesis research, I undertook an in-depth field study in Pontianak City, Indonesia. This study involved on-site observations at several key locations, such as the Department of Tourism, the Department of Communication and Information, and various integral sites within the Smart City Pontianak infrastructure. These site visits allowed me to gain valuable insights into the actual workings and the infrastructure of the city's smart city framework.

In addition to these observations, I conducted semi-structured interviews with leading figures in developing Pontianak's smart city initiatives, including a significant discussion with the head of the department responsible for the smart city projects. These interviews gave me a deeper understanding of the strategic, operational, and technological elements that drive the smart city initiatives in Pontianak. The details of the stakeholders that were interviewed are illustrated in Table 4.1. The information and insights from these field visits and interviews are key to my thesis, offering a detailed and practical perspective on implementing smart city strategies, especially smart tourism in Pontianak.

Table 4.1: Stakeholder Interviews

No.	Role	Department	Location
1	Head of Division	Communication and Information	Pontianak
2	Data Center Manager	Communication and Information	Pontianak
3	Programmer	Communication and Information	Pontianak
4	Programmer	Communication and Information	Pontianak
5	Head of Department	Tourism	Pontianak
6	Manager	Tourism	Pontianak

The development of the City of Pontianak focuses on the six dimensions of a smart city. Namely, the City of Pontianak has a mission to realize Smart Governance. The

rapid development of government services to the people of Pontianak City, proven by various awards received by the City Government, is the result of the Pontianak City Government's commitment to developing governance and managing good government according to the vision and mission created. With good local government governance, the community will have a high sense of trust in the government so that the government can maximize development with the community's full support. Several infrastructures, such as data centers, have been built to support the operation of smart city initiatives. Figure 4.2 shows the Pontianak City data centers office.

Figure 4.2: Pontianak Data Centers

The smart city vision of Pontianak in 2029 is "Pontianak, the equatorial city, smart, creative, innovative, and environmentally friendly," which aligns with the vision and mission of the Mayor of Pontianak and the city development plan for 2019–2024 (Mayor of Pontianak City, 2019). Hence, this city's vision and mission are translated into several goals within the project, which can be seen from the motivation viewpoint in this chapter. The resulting vision and mission will be to make Pontianak City a smart city. The smart city team perceives technological development and elements within it as being able to solve all problems, ranging from simple ones in the environment to wider urban problems. The development of the Pontianak Smart City, apart from having to answer the problems of the city of Pontianak, must also provide sustainable solutions. For this reason, cooperation between the government, the private sector, and the public is necessary to ensure the success of Pontianak Smart City. With good cooperation from all development stakeholders, it is hoped that other elements (branding, economy, living, society, and environment) can be immediately realized in Pontianak City. Based on the explanation of the master plan, the smart branding mentioned in the document is well aligned with the term smart tourism, which is the main issue of this research.

Therefore, the quick win target of each pillar is well documented in Figure 4.3.

Figure 4.3: Pontianak Smart City Quick Win Target

4.2 ArchiMate Baseline (as-is) Architecture

Baseline Architecture Modelling is the product that portrays the existing enterprise, the current business practices, and technical infrastructure. Through this model, this research has defined the current architecture of the Pontianak Tourism Initiative to realize smart tourism services to stakeholders. The baseline architecture consists of the motivation, organization, service realization, application usage, technology usage, and business process cooperation.

4.2.1 Smart Tourism Motivation Viewpoint

As the motivation viewpoint in Figure 3.2, Chapter 3 undercovers the underlying reason for the stakeholder to execute smart tourism. This section is specifically designed based on the Pontianak Smart City master plan. The whole documentation of the masterplan target in Figure 4.3 is translated to ArchiMate motivation viewpoint in the figure below.

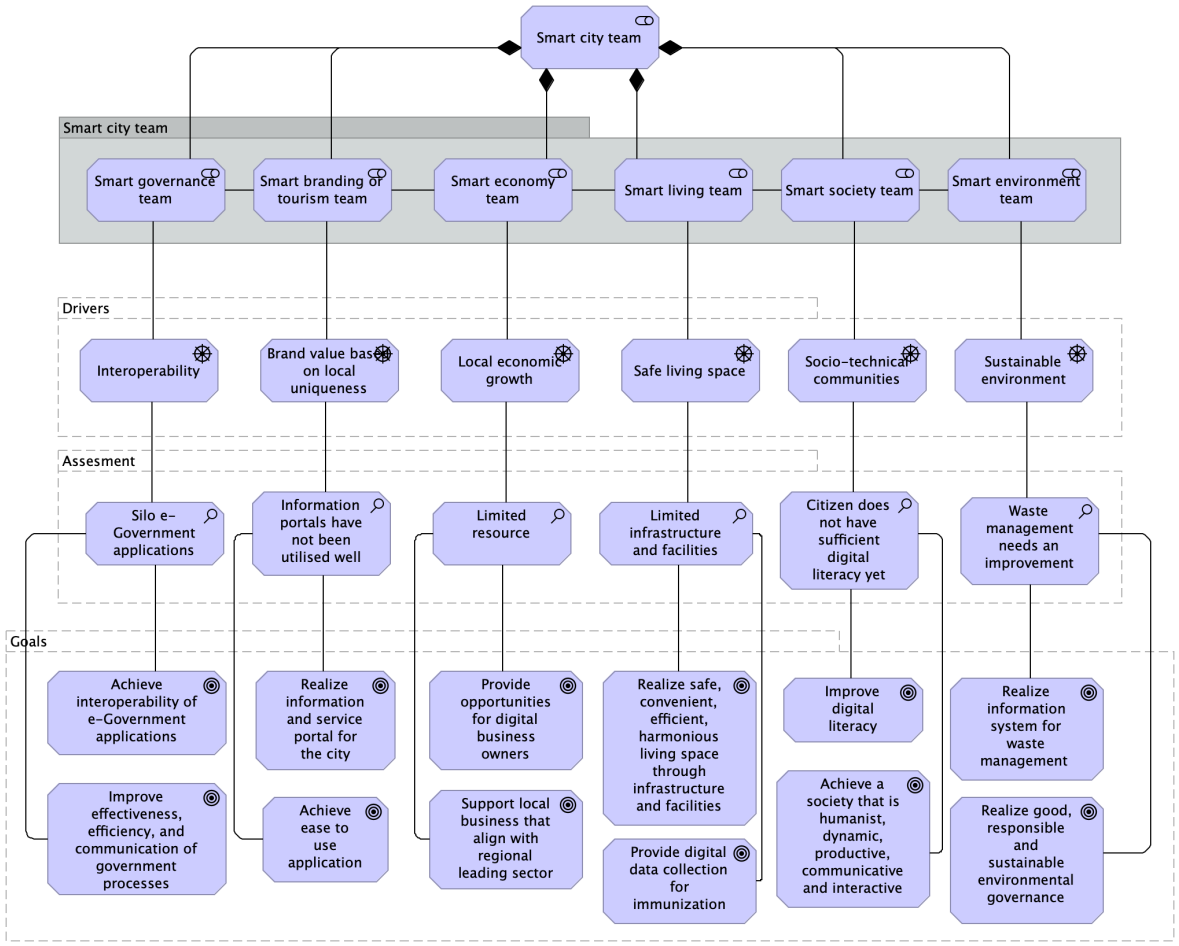

Figure 4.4: Baseline of Motivation Viewpoint

Based on the figure above, the motivation viewpoint includes all of the pillars in the Pontianak Smart City plan. Therefore, as this research focuses on smart tourism, the emphasis can be allocated to smart branding or tourism in Figure 4.4. There is a common ground between the reference architecture and findings found within the case study. The main driver of smart tourism in the project is to achieve brand value based on local uniqueness, which strongly relates to the driver of achieving tourism competitiveness in reference architecture in Chapter 3.

The goals that support the drivers are to realize an information portal for the city and achieve a use application, which also correlates to the goal in the reference architecture, facilitating business system interconnectedness. However, the challenges identified in Chapter 3 are mostly well aligned with the case study. The challenge is that developing countries need more resources to execute smart tourism. Furthermore, findings about smart tourism having a high cost in Chapter 3 also match with the answers from all of the experts that have been interviewed. Finally, understanding the project's current

situation will play a big role when designing the enterprise architecture.

4.2.2 Smart Tourism Organizations Viewpoint

The reference architecture of smart tourism organization viewpoint in Chapter 3 visualizes a proper ecosystem to execute smart tourism. However, in this section, the current conditions of stakeholder relation in the case study are shown in Figure 4.5.

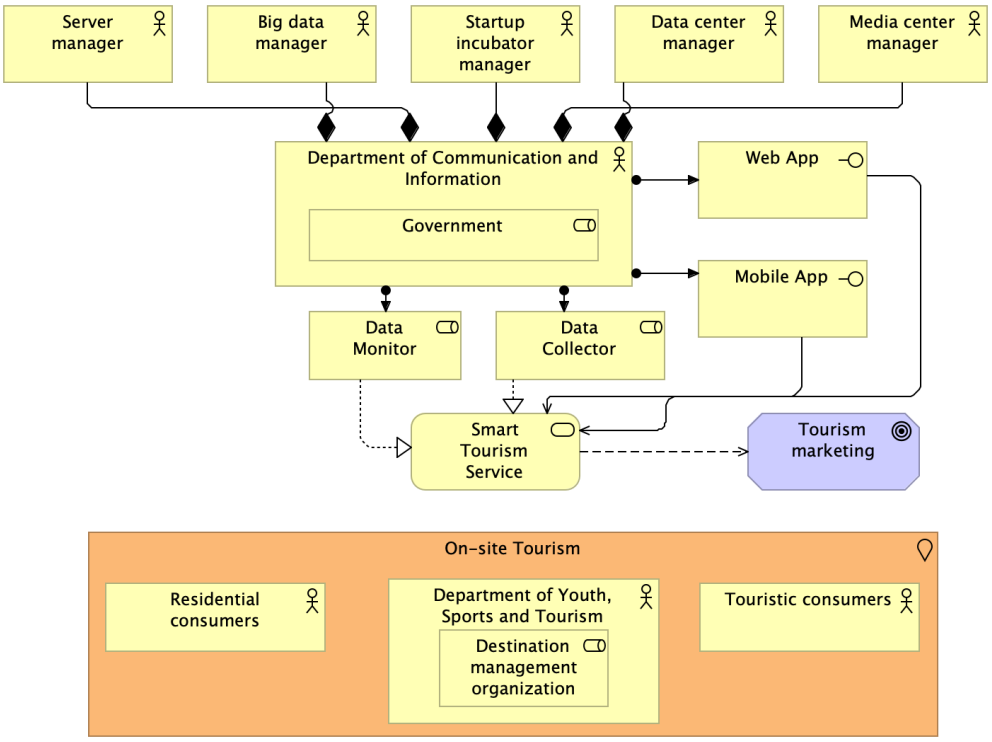

Figure 4.5: Baseline of Organizations Viewpoint
(Several smart tourism stakeholders proposed in Figure 3.5 are missing in the As-Is).

The figure above is visualized based on the government official document and expert interviews with the smart city team in this case study. The prominent insight is that the organizations within the project are isolated from each other. Therefore, silo organization and separated business activities are happening in the project. Currently, there are two huge actors within the Pontianak Smart Tourism initiative: the Department of Tourism and the Department of Communication. However, each organization has its business activities and roles despite having the same goal. The tourism department focuses on developing tourism spots, and the department of Communication focuses on developing the technology to publish tourism information. There needs to be coordination between the departments.

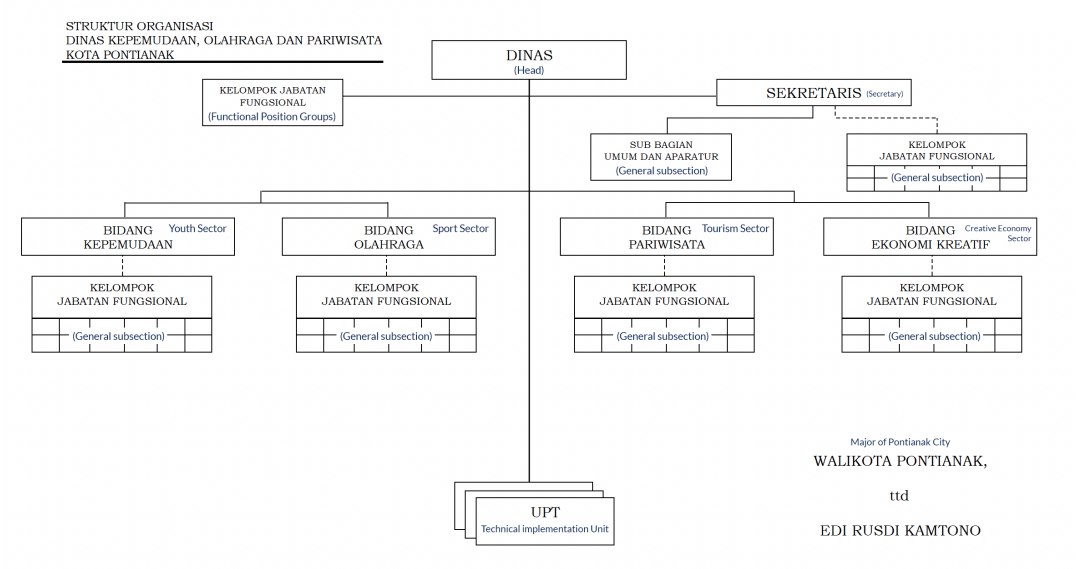

Figure 4.6: Structure of the Department of Tourism of Pontianak City

The communication and information department structure in Pontianak City for the Smart City project is illustrated in Figure 4.5 above. However, there is a business process gap between the Department of Communication and the Department of Tourism. Therefore, the Department of Tourism in Pontianak City has been investigated. A site observation and interview with the head and secretary brought some insights to the research. Figure 4.6 illustrates the structure of the organization in the Department of Tourism.

The interviews with department personnel enlighten an essential insight not elaborated on in the Figure above. No single role within the Department is responsible for managing the technology part of tourism. Therefore, the Department of Tourism relies on all the technology-related tasks of the Department of Communication and Information. However, to ensure interoperability of the smart tourism process, there needs to be an adjustment to the organization's structure.

The interconnected tourism business system has yet to be realized. Currently, the Department of Communication works independently to realize smart tourism, with several teams under the department. The teams are server manager, big data manager, startup incubator manager, data center manager, and media center manager. They play a role in monitoring and collecting the data to realize smart tourism services, which target increased tourism marketing.

4.2.3 Smart Tourism Service Realization Viewpoint

In the proposed reference architecture of the viewpoint of smart tourism service realization in Chapter 3, there are several standards of smart tourism services. However, the current condition of the smart tourism service the Pontianak Smart City provides is only one: Smart Branding. That service focuses on how the technology can increase the

online reputation of the tourism spot, which needs to cover the five main smart tourism services in Chapter 3. The framework suggests that the technology can integrate tourism activities into the technology, not only for displaying tourism information.

Smart tourism services are realized through the business process of providing an information portal. That business process is assigned to a smart city provider, which consists of several teams under the Department of Communication. Each team has its application, but the applications are siloed from each other. Therefore, the information needs to be integrated into the system. The Department of Communication fully operates that system without the aid of the Department of Tourism. The baseline of service realization viewpoint can be seen in Figure 4.7.

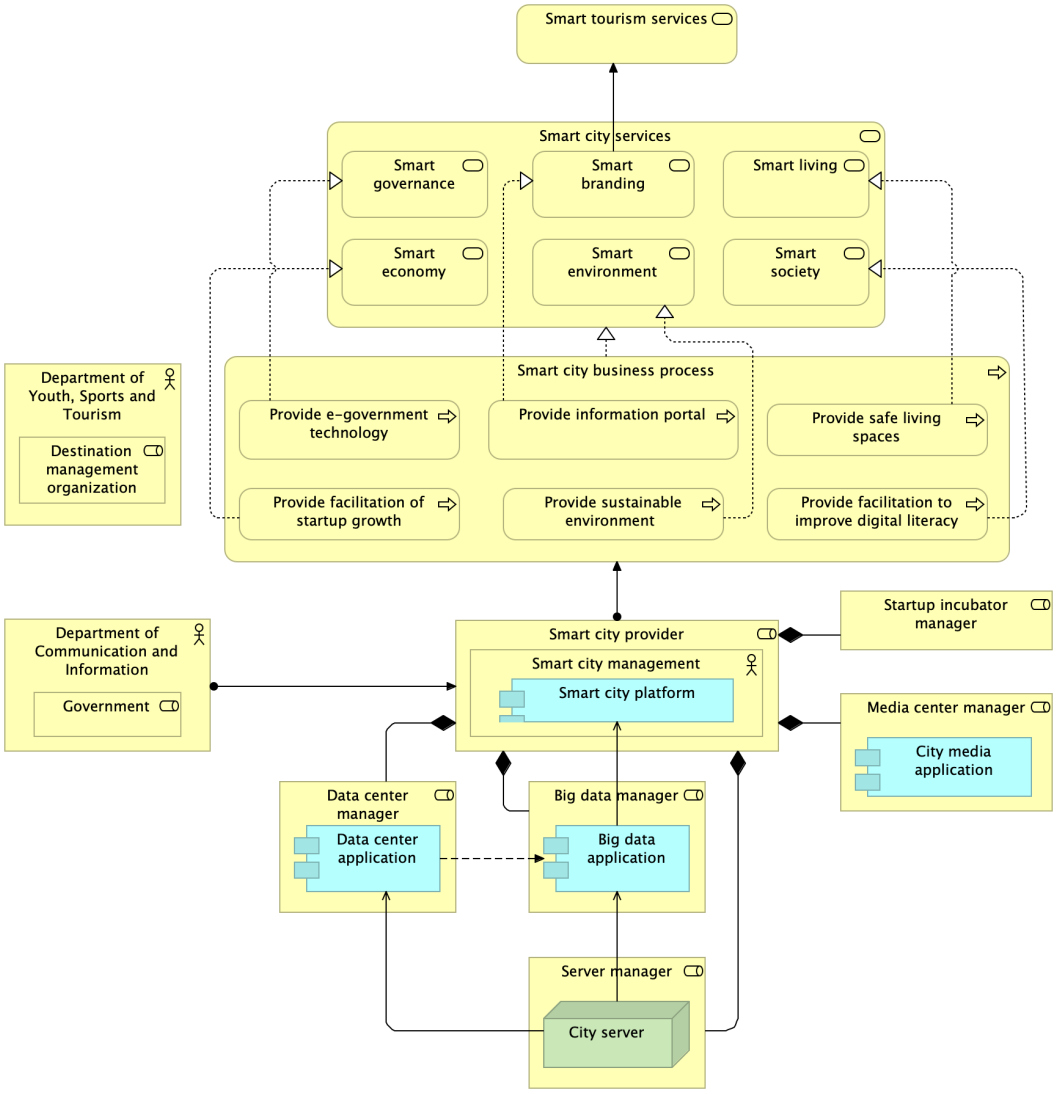

Figure 4.7: Baseline of Service Realization Viewpoint
(Smart tourism business services proposed in Figure 3.6 are missing in the As-Is).

4.2.4 Smart Tourism Application Usage Viewpoint

The proposed reference architecture of the application usage viewpoint in Chapter 3 shows the interrelationship between applications to realize smart tourism services to the stakeholders. The baseline of the application usage viewpoint can be seen in Figure 4.8.

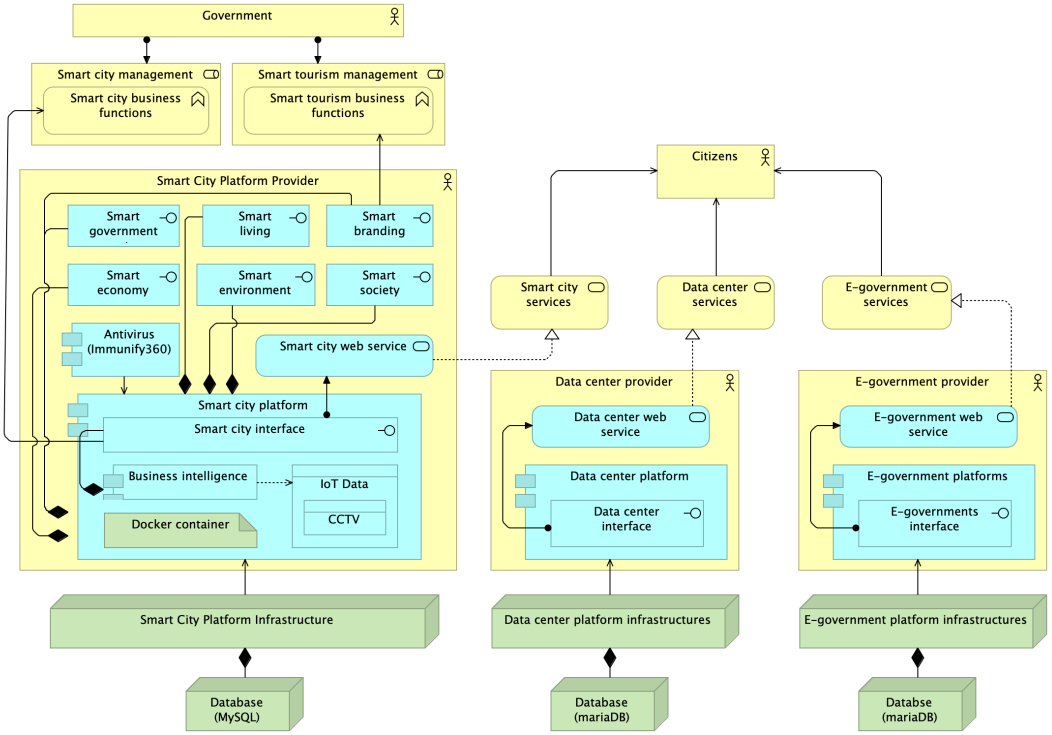

Figure 4.8: Baseline of Application Usage Viewpoint
(The application interoperability proposed in Figure 3.7 is missing in the As-Is).

As the figure above shows, three prominent applications operate within the Pontianak Smart City initiative. The applications are data centers, e-government, and smart city platforms. Each application has its technology infrastructure to support it. Specifically for the data center platform, it is supported by the mariaDB database. Thus, MariaDB also supports various e-government applications. Finally, the smart city platform is supported by MySQL.

The smart city platform consists of several application interfaces to serve the six main services, one of them being smart tourism. Within the smart city is a docker container for microservice in the application and business intelligence to process IoT data, mostly CCTV data. Afterward, each application serves business service independently to the citizen without any intersection between the services.

4.2.5 Marketing Business Process Cooperation Viewpoint

The reference architecture of marketing business process cooperation in Chapter 3 showcases the tourists' customer journey and stakeholders' impact on each travel phase. Figure 4.9 shows the baseline of marketing business process cooperation viewpoint.

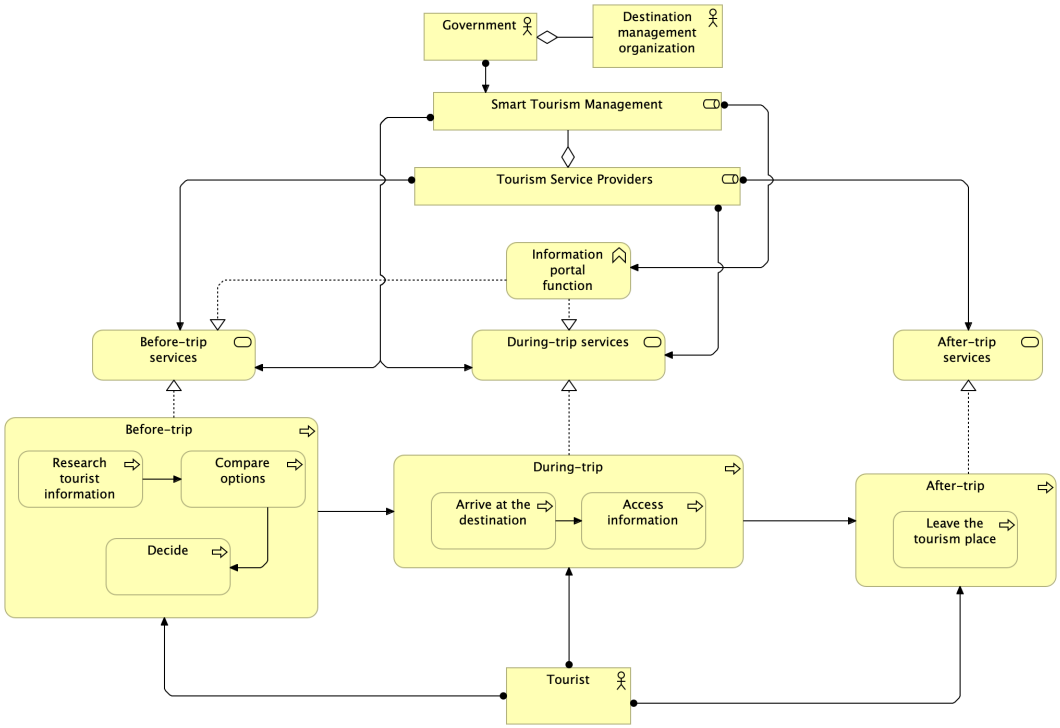

Figure 4.9: Baseline of Marketing Business Process Cooperation Viewpoint (The co-marketing business process proposed in Figure 3.9 is missing in the As-Is).

As shown in the figure above, the current state's marketing business process cooperation needs to align with the framework provided in Chapter 3. Currently, the Pontianak Smart City initiative stakeholders need to be coordinated better to serve the tourists in each of their travel phases. For instance, tourists can only read static information without additional features during the before-trip process. Afterward, during-trip, the tourist needs help to access real-time information and to use sufficient IoT technology to enrich their travel experience. Additionally, in the after-trip phase, the tourist needs the capability to advocate the tourist spot to their colleagues, which has yet to be realized.

For each travel phase mentioned, there needs to be a clear-cut ownership of who is responsible for supporting the tourist with their service. Currently, the Department of Communication focuses on building an information portal that is able to provide information. However, it does not cover the holistic business process for each customer journey in the tourism industry.

4.2.6 IoT Technology Usage Viewpoint

The proposed reference architecture of IoT technology usage viewpoint in Chapter 3 visualizes how IoT supports the smart city application. This section presents the current state of using IoT in the smart city application in the case study. The IoT technology usage viewpoint can be seen in Figure 4.10.

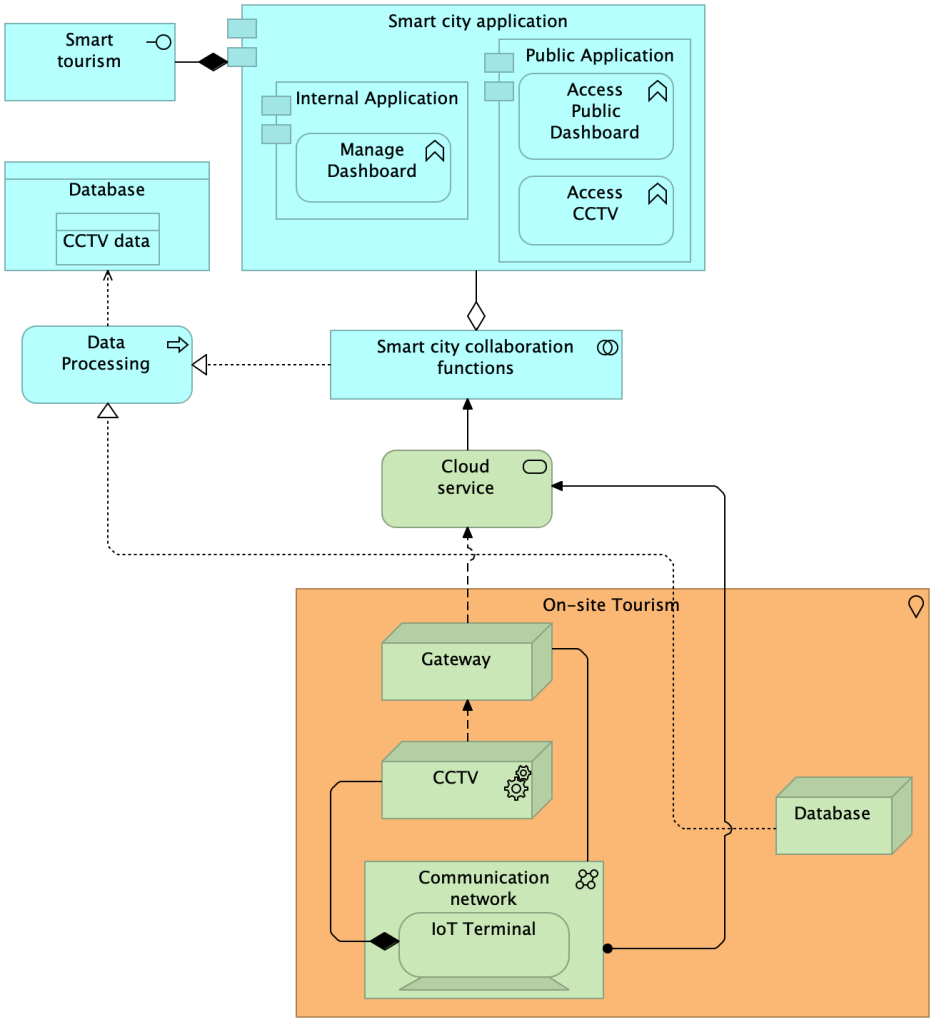

Figure 4.10: Baseline of IoT Technology Usage Viewpoint
(Fog and edge layers proposed in Figure 3.10 are missing in the As-Is).

As illustrated in the Figure above, the IoT technologies do not use fog layers as suggested by the proposed reference architecture. Currently, the only IoT device that is primarily used by the Pontianak Smart City initiative is CCTV. Therefore, the operations focus on how CCTV data is stored in the cloud service. Finally, the smart city application has an internal data management application. Additionally, a public application, which citizens can access through the website or visit the data center office in the government public area.

4.2.7 Conclusion of the Baseline

Based on the several baseline viewpoints provided in previous sections, several gaps are identified compared to the proposed reference architecture in Chapter 3. The main issues can be seen in Table 4.2 below.

Table 4.2: Conclusion of the Baseline

No.	Baseline Viewpoint	Main Issue
1.	Organizations Viewpoint	Several smart tourism stakeholders proposed in Chapter 3 are missing. Therefore, coordination between stakeholders is difficult to realize.
2.	Service Realization Viewpoint	Smart tourism business services proposed in Chapter 3 are missing. Hence, the proper smart tourism services will fail to be delivered to the tourists.
3.	Application Usage Viewpoint	The application interoperability proposed in Chapter 3 is missing. Thus, the silos application hinders the realization of integrated smart tourism applications.
4.	Business Process Cooperation Viewpoint	The co-marketing business process proposed in Chapter 3 is missing. Therefore, coordination to promote tourism activities lacks guidelines.
5.	Technology Usage Viewpoint	Fog and edge layers proposed in Chapter 3 are missing. Thus, a plan to realize efficient communication of IoT technologies is absent.

From the perspective of the organization, the model must be completed, as it needs more representation from key stakeholders within the smart tourism ecosystem. Furthermore, from the standpoint of service realization, there is a gap that suggests a risk that the services envisioned may fail to reach tourists effectively. For application usage, current applications operate in isolation, preventing seamless integration for an efficient smart tourism experience. Afterward, in terms of business collaboration, the document needs to detail a strategy for joint marketing, which is key to promoting tourism activities. Without such a strategy, there is a risk of uncoordinated marketing efforts and lost opportunities for collaboration amongst tourism service providers. Finally, regarding IoT technological usage, the proposed framework must incorporate technological layers such as fog and edge computing, essential for effectively deploying IoT technologies within the smart tourism sector.

The outlined problems highlight areas for baseline improvement compared to the proposed reference architecture of smart tourism discussed in Chapter 3. These deficiencies include stakeholder engagement, service delivery, application functionality, collaborative business strategies, and technological infrastructure. These challenges must be addressed to forge a successful path forward for smart tourism initiatives. Therefore, the following section, Target Architecture, will discuss the solution to tackle the gap in Baseline Architecture.

4.3 ArchiMate Target Architecture

A target architecture establishes the structure for strategizing, allocating resources, and optimizing operations to achieve a desired future. The target architecture is the guiding plan that enterprise architects and project managers must follow. The target architecture comprises the organization, service realization, and application usage. Regarding the IoT technology usage viewpoint and the marketing business process cooperation viewpoint, there are no changes made from the reference architecture as the target architecture. Therefore, those two viewpoints are not visible in this section.

4.3.1 Smart Tourism Organizations Viewpoint

As the baseline of smart tourism organization viewpoint in Figure 4.5 in Chapter 4 undercover the organizations' current state in the case study, this section describes the ideal state for the organization. The ArchiMate of the target of organization viewpoint can be seen in Figure 4.11.

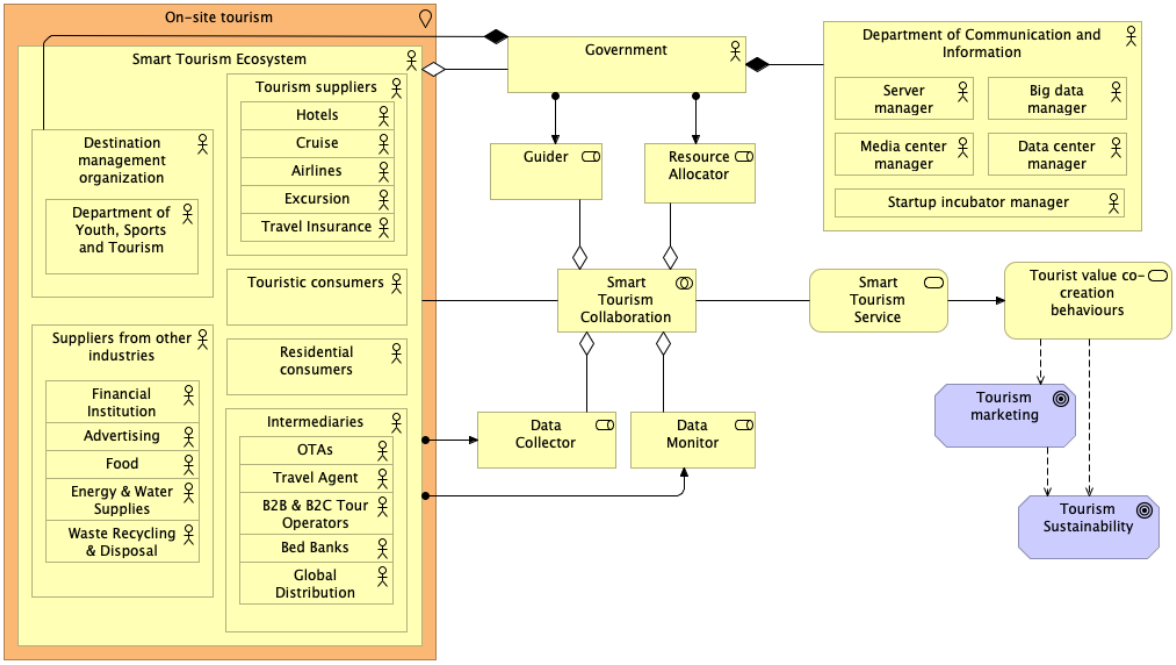

Figure 4.11: Target of Organization Viewpoint
(Adjustment of the relations between smart tourism stakeholders compared to the As-Is in Figure 4.5).

As the figure above visualizes, the smart tourism ecosystem is mapped accordingly with the case study. Within the ecosystem, there are several parties involved in the process. The categories include touristic customers, residential consumers, tourism suppliers, cross-industry suppliers, government agencies, destination marketing organizations, and intermediaries (Gretzel, Werthner, et al., 2015). As the guide and resource allocator, the government plays a huge role. Specifically, the Department of Communication coordinates the smart tourism operations between the stakeholders. The government also has a role as a destination management organization, which is the Department of Tourism.

Furthermore, the stakeholders need to be able to do data collection and data monitoring of IoT tourism data. Hence, the stakeholders can use the data to improve their tourist service. The collaboration of the activities will trigger the tourist value co-creation behaviors. Finally, it will improve tourism marketing, which is the main goal of the Pontianak Smart Tourism / Branding. Following, the marketing will improve tourism sustainability, which correlates with the findings in the systematic literature review.

4.3.2 Smart Tourism Service Realization Viewpoint

The baseline of smart tourism service realization viewpoint in the previous section of Chapter 4 covers the current state of how the government realizes smart tourism services. The key aspect of this architecture is smart tourism business collaboration. Since the organization's current state is quite isolated, smart tourism is hard to realize. Furthermore, business activities within the government still need to be well integrated. Afterward, the government can coordinate other tourism companies related to smart tourism activities.

The target of the smart tourism service realization viewpoint can be seen in Figure 4.12. The Department of Tourism in the government is responsible as a destination management organization that is expected to flow the information to the Department of Communication. Department of Tourism's business activities related to smart city plans are integrating tourism objects, developing cultural objects, promoting tourism and events, revitalizing tourism objects, developing art, and developing cultural heritage (Mayor of Pontianak City, 2019). Thus, the Department of Communication should be able to realize a technology that can integrate external tourism companies to access smart tourism platforms. Therefore, it will trigger collaboration between the stakeholders. Finally, that collaboration triggers the smart tourism business process and realizes the smart tourism service for the tourist.

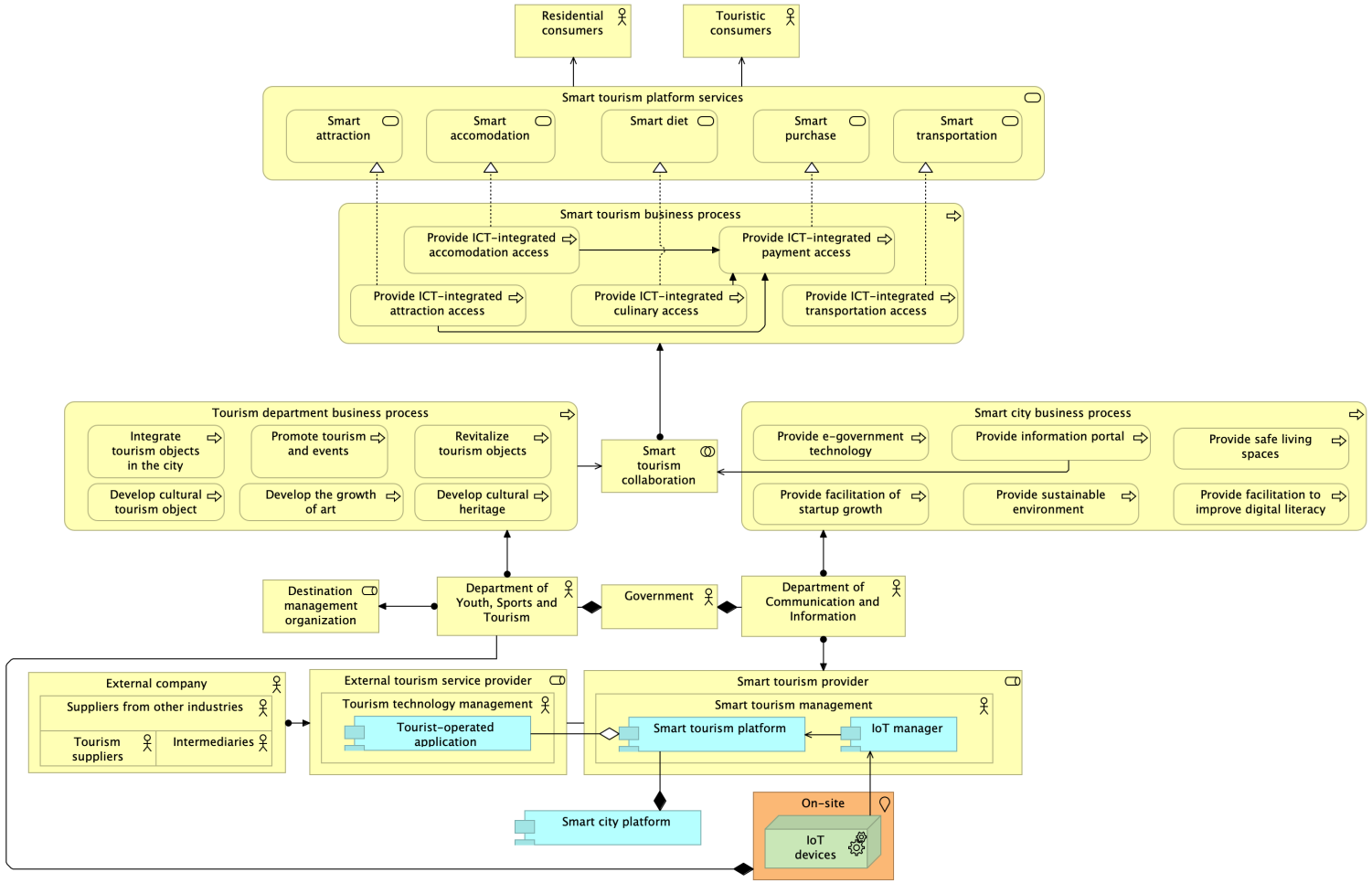

Figure 4.12: Target of Service Realization Viewpoint
(Adjustment of the realization of smart tourism business services aligned to the As-Is conditions within the Government Plan in Figure 4.7).

4.3.3 Smart Tourism Application Usage Viewpoint

The previous section in Chapter 4 revealed the current state of silo applications in the case study regarding the usage viewpoint of smart tourism applications. That pattern will hinder achieving a smart tourism target: tourist value co-creation behaviors. This section will describe the target of smart tourism application usage viewpoint.

The smart tourism experience enhances the actual tourist visit by providing real-time content and enriching the pre-trip, during-trip, and post-trip phases, enabling the sharing of tourism experiences. Technology is crucial in strengthening the connection between service providers, tourist associations, destinations, and consumers. The key drivers of this smart tourism experience include the aggregation of information, ubiquitous connectivity, and real-time synchronization (Neuhofer, Buhalis, & Ladkin, 2015).

Key factors such as technological advancements, innovative practices, digital spaces, efficient information processing, and the deployment of smart tools and ICT infrastructure, such as cloud computing and the Internet of Things, are fundamental in establishing the smart tourism ecosystem (Xiang et al., 2014). This integration facilitates real-time awareness of the physical world and advanced analytics, empowering individuals to make more informed decisions about various choices and actions. These informed decisions aim to optimize business processes and enhance overall business performance.

The essential element of this viewpoint is integrating cloud service platform infrastructure to integrate numerous e-government applications and external tourism applications within the system. Currently, the government has several applications to manage each business activity. Therefore, they have some silo applications that are not connected to each other. The proposed architecture integrates all applications under the smart city platform, realizing seamless features for smart governance services. Thus, it will enhance the government's efficiency in its activities. Afterward, the government should be able to manage external tourism companies to enhance the tourist experience. The data integration would give valuable insight for the tourism company to enhance their service for the tourists. Examples of tourism companies include airlines, excursions, cruises, and hotels. Finally, that collaboration will realize smart tourism services and external tourism services for the citizens. The target of the smart tourism application usage viewpoint can be seen in Figure 4.13.

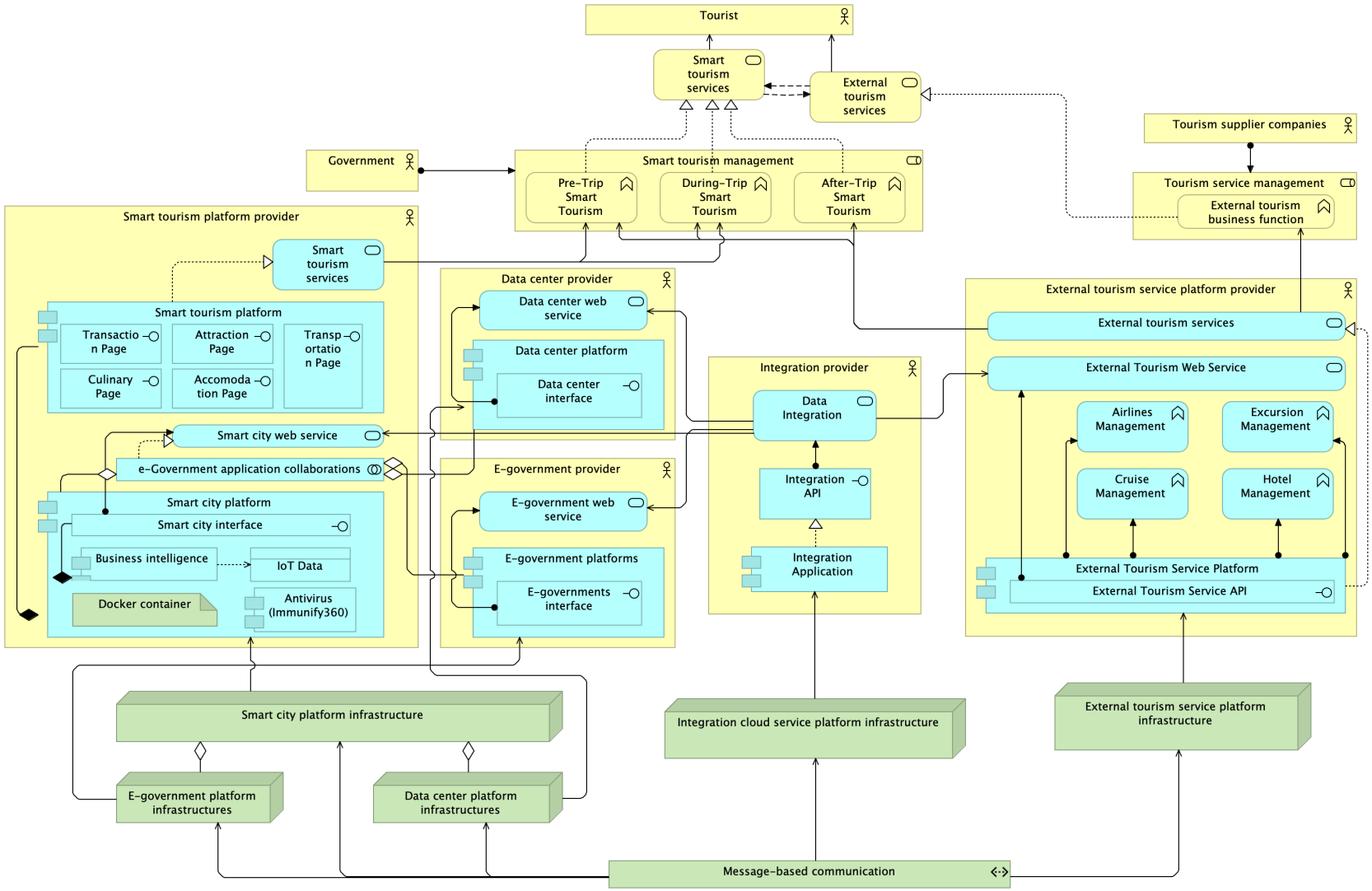

Figure 4.13: Target of Application Usage Viewpoint
(Adjustment of the interoperability of applications to support each of the smart tourism business functions, which is missing in the As-Is in Figure 4.8).

4.3.4 Conclusion of the Target

Table 4.3 outlines strategic measures to refine the viewpoints based on the main issues identified in Table 4.2.

Table 4.3: Conclusion of the Target

No.	Target Viewpoint	Solutions
1.	Organizations Viewpoint	Adjustment of the relations between smart tourism stakeholders according to Chapter 3. This adjustment will realize each stakeholder's enablement and role in realizing smart tourism collaboration.
2.	Service Realization Viewpoint	Adjustment of the realization of smart tourism business services aligned to the As-Is conditions within the Government Plan. This solution addresses business processes that realize the smart tourism services and align with the current business process in the case study.
3.	Application Usage Viewpoint	Adjustment of the interoperability of applications to support each of the smart tourism business functions, which is missing in the As-Is. Thus, the target viewpoint can address essential applications in the smart tourism business functions.
4.	Business Process Cooperation Viewpoint	The main solution is to realize the co-marketing tourism business process that transforms each stakeholder to produce and consume data that enriches the tourism experience. Further adjustment in Chapter 4 is unnecessary since Chapter 3 proposed reference architecture is sufficient as the target according to the As-Is.
5.	Technology Usage Viewpoint	The coordination of cloud, fog, and edge layers that improve the latency of IoT data will improve communications. Further adjustment in Chapter 4 is unnecessary since Chapter 3 proposed reference architecture is sufficient as the target according to the As-Is.

The first point highlights a need to improve how smart tourism stakeholders operate based on the guidelines in Chapter 3. Such realignment is expected to support each party's contribution to and participation in collaborative tourism activities. The second point emphasizes the importance of adapting smart tourism service implementation to fit the real-world scenarios presented in the Government Plan. This approach is designed to ensure that smart tourism services are conceptualized and practically integrated within existing business operations, as the case study provides. The third point addresses the need to enhance the compatibility of applications to support fundamental smart tourism business activities. This enhancement is important for bridging the gap identified in the current model and ensuring that applications meet the industry's needs. The fourth point centers on implementing a co-marketing strategy that would effectively empower stakeholders to coordinate the tourism phase, thereby enriching the tourism experience. The fifth and final point highlights the significance of integrating advanced computing layers to enhance IoT data transfer and communication.

The proposed solutions aim to refine the baseline of smart tourism by strengthening stakeholder engagement, service delivery, application interoperability, marketing business collaboration, and technological infrastructure. These refinements are presented as essential for the creation of an integrated smart tourism environment.

4.4 ArchiMate Migration Architecture

The migration viewpoint involves utilizing models and concepts to precisely define transitioning from a current design to a desired one (Open Group, 2021). TOGAF operates on the fundamental principle that diverse designs are defined for distinct phases. Architects develop a Baseline Architecture and a Target Architecture. Afterward, these architectures comprehensively describe the existing and anticipated future states, respectively. The migration Architecture depicts the enterprise in incremental stages representing transition periods between the Baseline and Target Architectures. Transition Architectures facilitate the organization of individual work packages and projects into controlled portfolios and programs, demonstrating the commercial value at each level (Open Group, 2021).

The smart tourism migration viewpoint is defined as visualized in Figure 4.14. The plateau of baseline to migration has a gap to address: a lack of guidelines and collaboration in smart tourism management. Therefore, the government must tackle the challenge before executing smart tourism. Afterward, the smart tourism migration plan should realize smart tourism collaboration between the stakeholders and official smart tourism guidelines for involved parties. Two deliverables should be delivered to realize those goals: migrated business processes and transformed technologies. Business process migrations consist of a business transformation plan and collaboration of a smart tourism ecosystem. Thus, they will realize adequate requirements of well-trained personnel and partnership with the stakeholders. Finally, the goals of increased digital literacy of citizens to participate and increased citizen participation and engagement in smart tourism management will be achieved. Furthermore, technology transformation consists of the transformation plan, streamlining, and modernizing applications and technologies. Thus, it supports the requirement of a streamlined and modernized technology landscape that supports the goal of optimized application usage throughout the smart tourism platform.

The gap in smart tourism design, development, and management has been identified between the plateau of migration and the target. The essential element of smart tourism's target is realizing the co-creation process, influencing the stakeholder as the prosumer, and integrating the smart tourism platform. A work package of smart tourism initiatives is required to realize the target. The deliverables include a smart tourism application, a smart tourism ecosystem, and a smart tourism policy. Therefore, it realizes the establishment of a smart tourism information portal, integrated application across the system, well-coordinated stakeholders, and implemented standards across smart tourism operations. Sequencely, the requirements will realize well-known tourism based on local uniqueness, improved effectiveness, efficiency, and communication of digital government process, and achieve a humanist, dynamic, productive, communicative, interactive, and sufficient digital literacy society. Finally, those positively influence the goal of increased local tourism competitiveness and brand value between stakeholders.

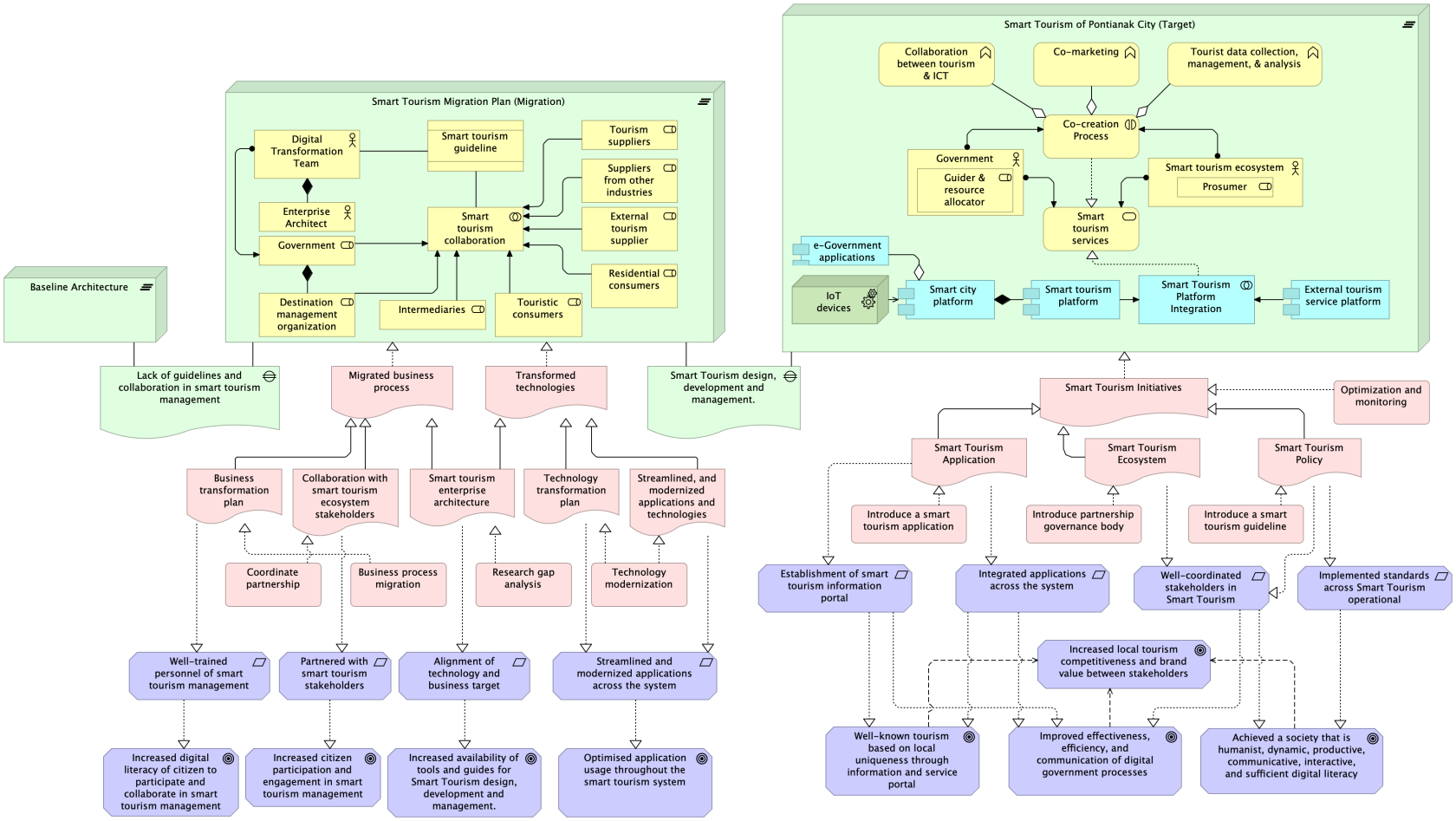

Figure 4.14: Migration Viewpoint

4.5 LeanIX Workspace of Reference Architecture

In the enterprise architecture management (EAM) context, a LeanIX workspace constitutes a cohesive aggregation of Fact Sheets, including users and viewers. Typically, a singular workspace is employed by an organization to facilitate its EAM operations. However, there exist scenarios where the utilization of multiple workspaces is advantageous. Such instances may arise where distinct organizational segments or subsidiaries are present, necessitating the establishment of separate, concurrent workspaces for optimal management and organizational efficiency.

4.5.1 Objective Report

As the previous section's motivational viewpoint undercovers the stakeholder's reason for executing smart tourism, this section aligned the ArchiMate with the LeanIX objective report. The concept of 'Objectives' holds a place of main priority. These objectives are the benchmarks an organization sets out to achieve, and they play a critical role in steering initiatives designed to enhance Business Capabilities and evolve the IT landscape. The encapsulation of these objectives is meticulously documented in the 'Objective Fact Sheet.' This document is crucial as it establishes the Key Performance Indicators (KPIs) that are fundamental in gauging the success of these objectives. A key feature of this methodology is the strategic linkage of objectives to Business Capabilities and Initiatives. This linkage is vital as it facilitates the continuous monitoring and assessment of progress over time.

The main objective of smart tourism in the case study is "Increased local tourism competitiveness and brand value between stakeholders." It was visualized harmoniously through the motivation viewpoint and migration viewpoint. Furthermore, the government has several goals supporting the main goal mentioned before. Within the LeanIX workplace, it is illustrated as objective children in the main goal. In addition, we can align them with the current business capability supporting the objective.

The extra feature in LeanIX is that the architect can navigate easily through every fact sheet. In this objective report, the color represents whether or not the application in the business capability can support the business objective. Red represents unreasonable, yellow represents insufficient, light green represents appropriate, and dark green represents perfect. The number of globe icons represents the "Maturity of Business Capability," the left represents the current, and the right represents the target maturity. This visualization can help the architect know the current condition of the project and navigate it. As illustrated, many business capabilities have an unreasonable application functional fit, which may hinder the achievement of the project's objective. The objective viewpoint can be seen in Figure 4.15 below.

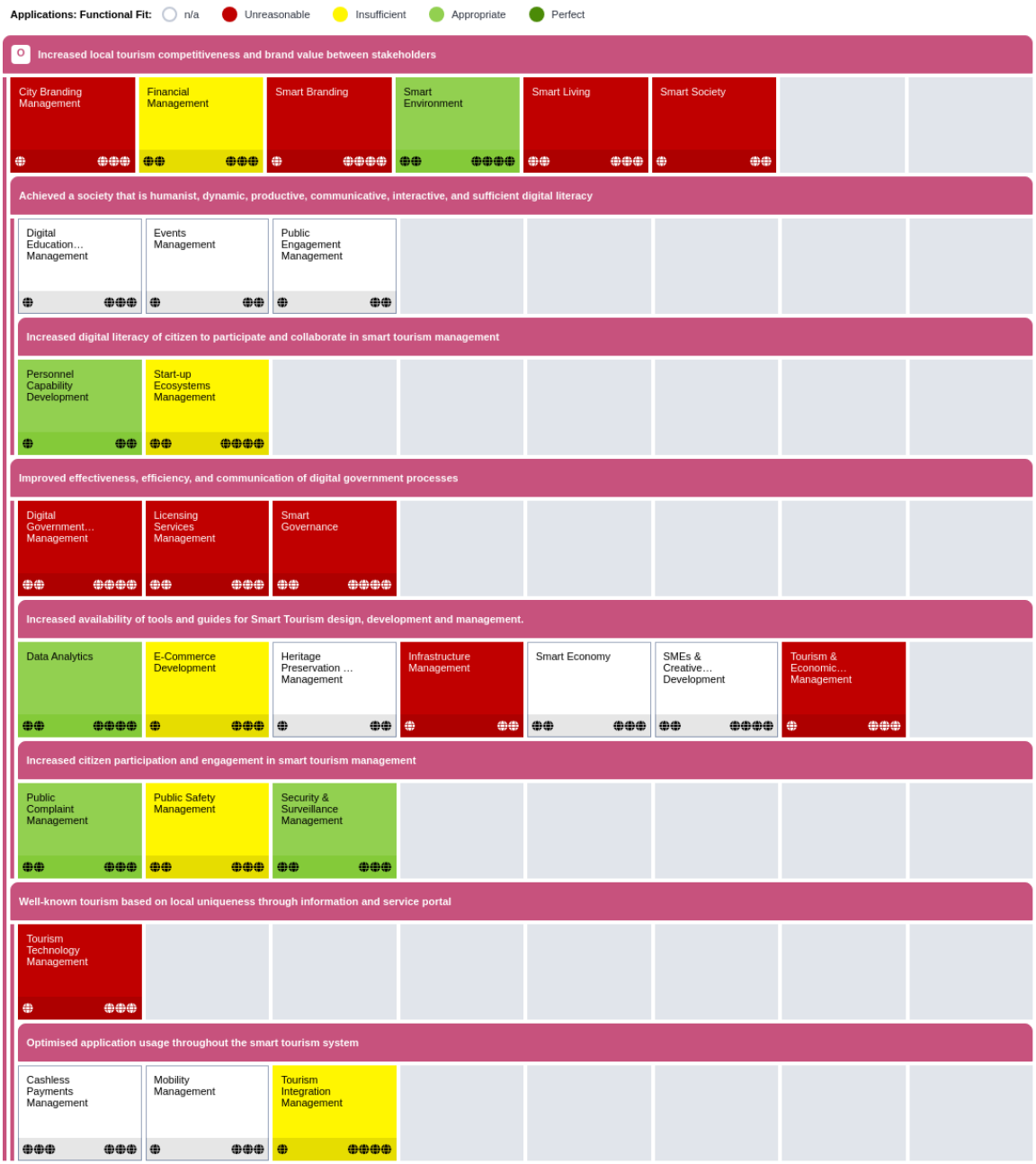

Figure 4.15: LeanIX Objective Report

4.5.2 User Group Report

The key stakeholders in the smart tourism project have been identified in the previous section, which is the smart tourism organization viewpoint with ArchiMate. This visualization is translated into a LeanIX user group or organization report. The role of organizations as users or owners of applications is a topic of significant interest. These

organizations can be conceptualized and modeled within various dimensions, creating hierarchical structures essential for understanding the organizational framework. Within the LeanIX platform, the 'Organization Fact Sheet' type emerges as a critical tool for representing an organization's business architecture. Its utilization from the outset is recommended, as it provides foundational views instrumental in discerning synergies and identifying gaps within the application landscape across diverse organization segments.

The 'Organization Fact Sheet' is designed to outline who utilizes specific organizational applications. LeanIX facilitates this understanding through the incorporation of five major Fact Sheet subtypes. These subtypes cater to the dimensions most commonly captured by LeanIX users: Business Unit, Customer, Region, Legal Entity, and Team. Each of these subtypes serves a distinct purpose in articulating the multifaceted nature of an organization's application usage. By employing these subtypes, researchers and practitioners can gain a more nuanced understanding of the application landscape, aiding in the strategic decision-making process and the effective management of technological resources within the organization.

The smart tourism stakeholders are populated into the "Sub Group" fact sheet that includes seven main stakeholders (government, destination management organization, tourism supplier, supplier from other industries, tourist consumer, residential consumer), which is the finding from the previous section. Afterward, the enterprise architect is able to navigate the actual stakeholders that belong to the group. It enables the project manager to manage the stakeholders actively and ensure the collaboration happens holistically. The user group report is shown in Figure 4.16 below.

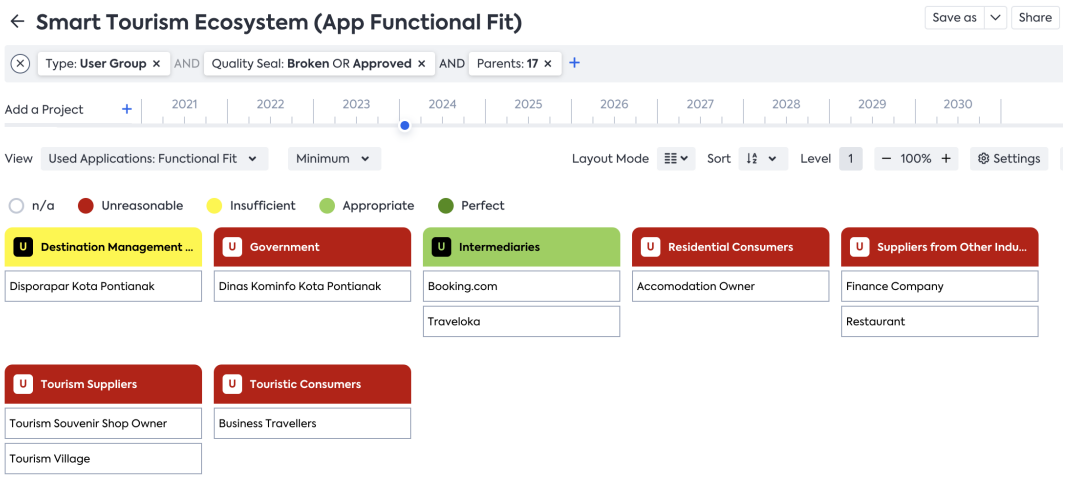

Figure 4.16: LeanIX User Group Report

4.5.3 Business Capability Report

The previous viewpoints of smart tourism service realization and business process collaboration viewpoint undercover the project's business-related activities through ArchiMate. As the previous findings show the relation of business processes with the language of ArchiMate, this section emphasizes translating them into LeanIX. The 'Business Capabilities' concept in LeanIX is recognized as a fundamental framework for structuring and articulating the essential elements required for an organization to execute its business model effectively. These capabilities are distinguished by their formulation in business-centric language. This common linguistic ground ensures that business capabilities are accessible and relevant to all organization members, fostering a unified understanding. They function as an abstraction, representing the underlying functionality and processes without delving into specific operational details. The business capability report can be seen in Figure 4.17 above.

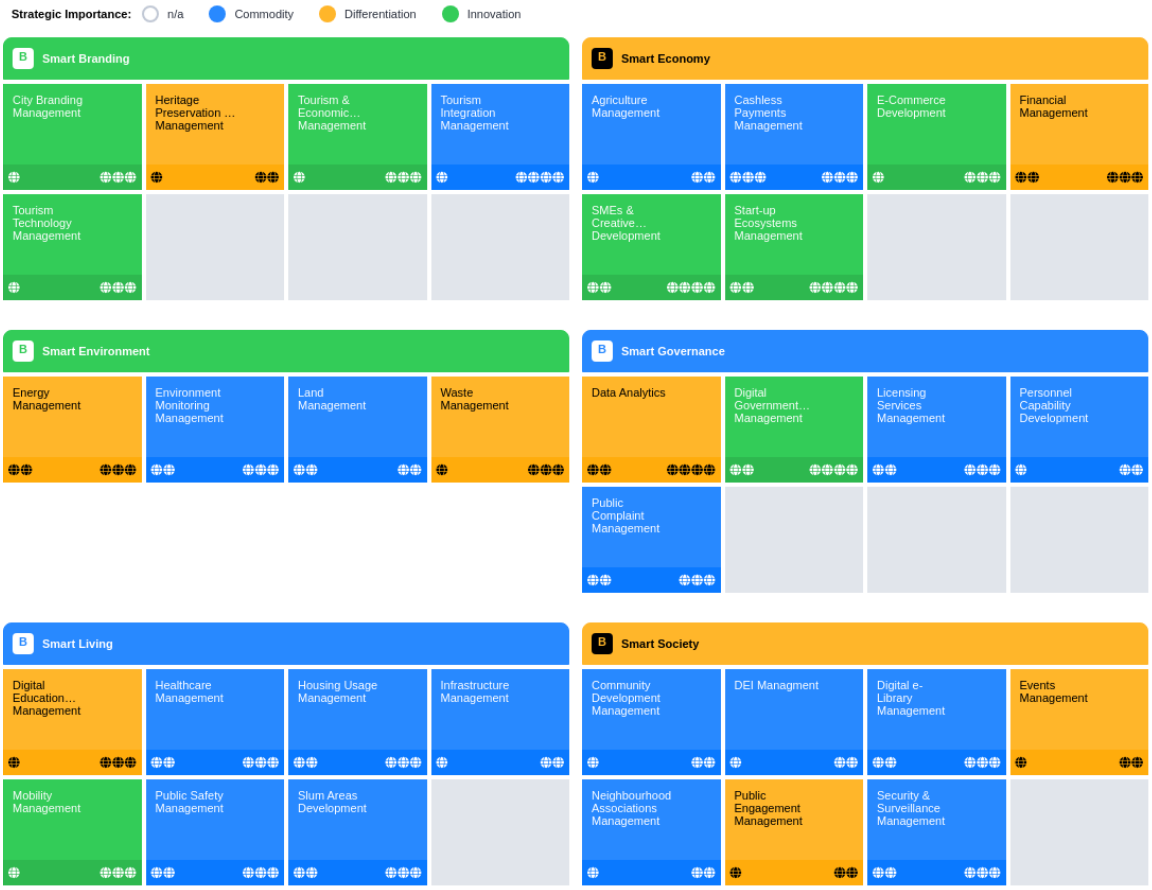

Figure 4.17: LeanIX Business Capability Report

Within the LeanIX platform, the 'Business Capability Fact Sheet' is a high-level overview of an organization's functional capacity and potential. It focuses on what the

business accomplishes and can achieve, abstracting from the methodologies and resources employed in these processes. This approach establishes a foundational understanding of the organization's capabilities and facilitates a holistic view of the application portfolio, enhancing strategic alignment and operational efficiency.

From the previous findings in the expert interview, six main business functions for the smart city in Pontianak City have been identified. They are smart economy, smart branding, smart living, smart society, smart governance, and smart environment. Each of them is translated into a business capability fact sheet with children's business capabilities identified based on official government documents. Thus, each business capability is identified by its strategic importance to understand the project's urgency. Blue color represents commodity, which is a daily business operation. Orange color represents differentiation, which means the business capability needs to have added value to be able to achieve the objective. Finally, the green color represents innovation, and the business capability needs to have a competitive advantage to bring something new to the industry. Therefore, to support the objective, several business capabilities must be in the innovation stage but still have a low maturity stage. Thus, this workspace can help the management understand the current business capability and the relations to every fact sheet they have.

4.5.4 Application Portofolio and Landscape Report

The previous viewpoints on smart tourism application usage viewpoint elaborate on how ArchiMate visualizes application relations in the project. One of the two reports that describe the relations of application in LeanIX software is the LeanIX application portfolio report. The LeanIX Portfolio Report emerges as a notable analytical tool. This report effectively categorizes various entities such as Applications, Projects, or Providers, organizing them based on specific characteristics like functional and technical suitability. Its methodology draws inspiration from the TIME (Tolerate, Invest, Migrate, Eliminate) assessment framework developed by Gartner, a renowned authority in the IT industry. This alignment with Gartner's framework enhances the report's utility in pinpointing organizational areas that may require focused attention or intervention.

A particularly insightful aspect of the Application Portfolio report within LeanIX is its ability to analyze the portfolio through the lens of 'Business Criticality' versus 'Functional fit.' This dual-dimensional analysis allows for a nuanced assessment of applications within the organizational ecosystem. The Figure 4.18 of the application portfolio below illustrates that the bigger the circle, the bigger the application is categorized in that group. Therefore, it shows that many applications have high importance on the business side, but the current application could not fulfill the business goal. This visualization helps the project manager to manage the allocation with the TIME assessment framework.

The Landscape Report offered by LeanIX is designed to provide a comprehensive overview of an organization's IT landscape, capturing a snapshot of a particular moment or trend over a specified period. Its utility lies in its capacity to organize and present data according to various parameters, such as Business Capabilities and Technology

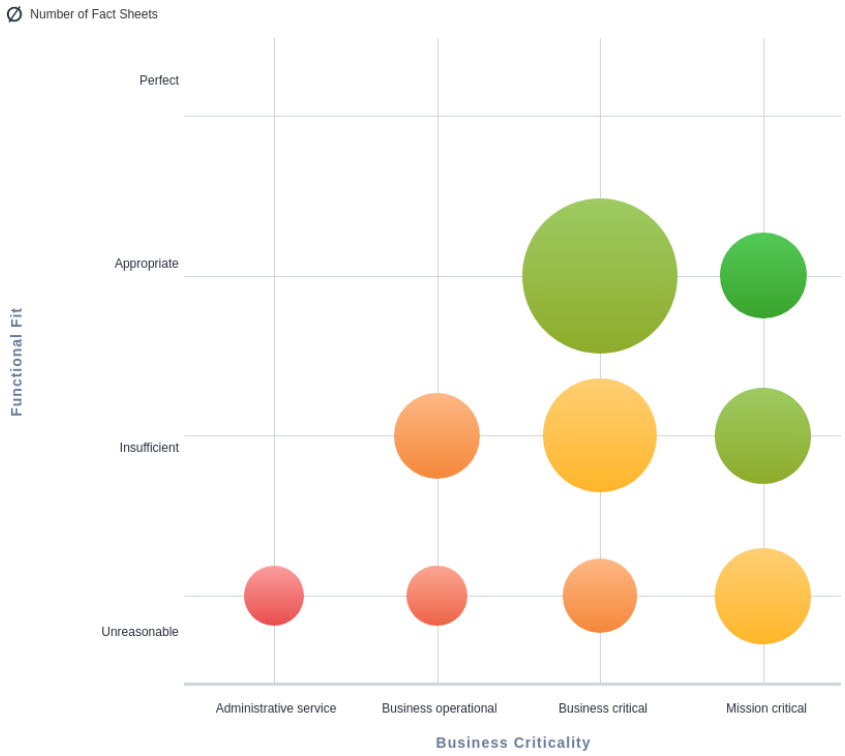

Figure 4.18: LeanIX Application Portofolio Report

Categories. The application of the Landscape Report in LeanIX extends beyond mere informational purposes; it serves as a strategic tool enabling organizations to make informed decisions regarding their IT investments. The report is instrumental in the process of rationalization and optimization. Identifying redundant applications and flagging outdated systems aids in streamlining the IT infrastructure, thereby reducing complexity and associated costs.

Another significant aspect of the Landscape Report is its contribution to prioritization in IT decision-making. IT leaders can leverage the insights provided by the report to discern which projects and investments are paramount for the organization's success. This prioritization is guided by understanding the critical business capabilities and applications, ensuring that resources are allocated to areas that yield the highest impact on organizational goals.

Furthermore, it can highlight 'Active' Applications that are deemed critical to business operations but need to be improved in terms of Functional Fit. Such insights are crucial for guiding strategic decisions regarding optimizing, upgrading, or potentially phasing out various applications and aligning the IT landscape with the overarching business strategy and operational needs. As visualized in Figure 4.19 below, several applications are not active anymore and need to be managed by the management.

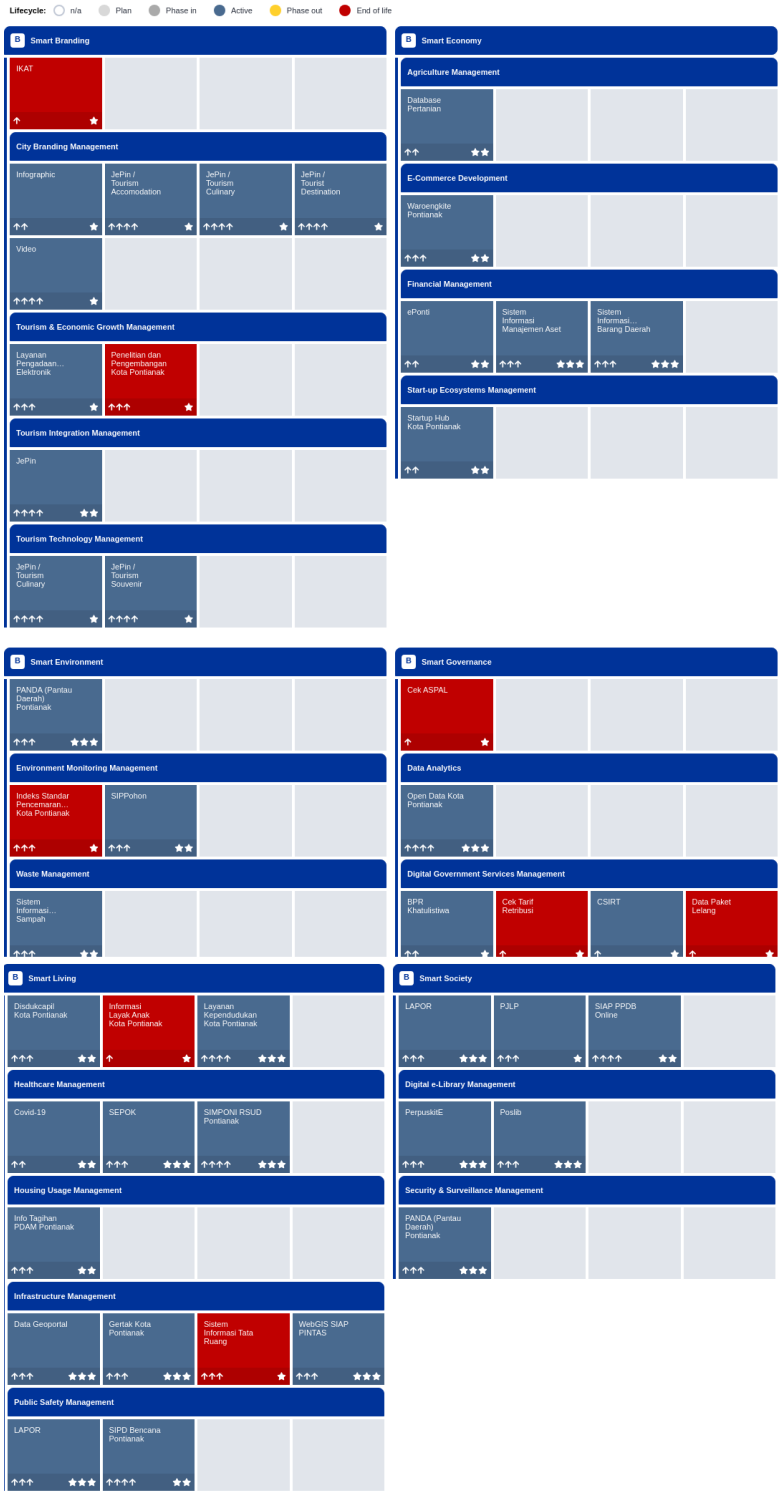

Figure 4.19: LeanIX Application Landscape Report

4.5.5 Project Roadmap

The migration viewpoint illustrates the transformation of the baseline plateau to the target plateau in ArchiMate. Thus, this section translates that viewpoint into the LeanIX meta-model through the project roadmap. The Roadmap Report within the LeanIX EAM framework is critical for visualizing and planning an organization's future architectural course. This report effectively encapsulates the strategic initiatives, projects, and priorities an organization intends to pursue to realize its envisioned future state. Its significance lies in its ability to bridge the alignment of IT investments and resources with the broader business objectives of the organization. This alignment is crucial for coherent organizational growth and development. The project roadmap, which is aligned with the Archimate, can be seen in Figure 4.20 below.

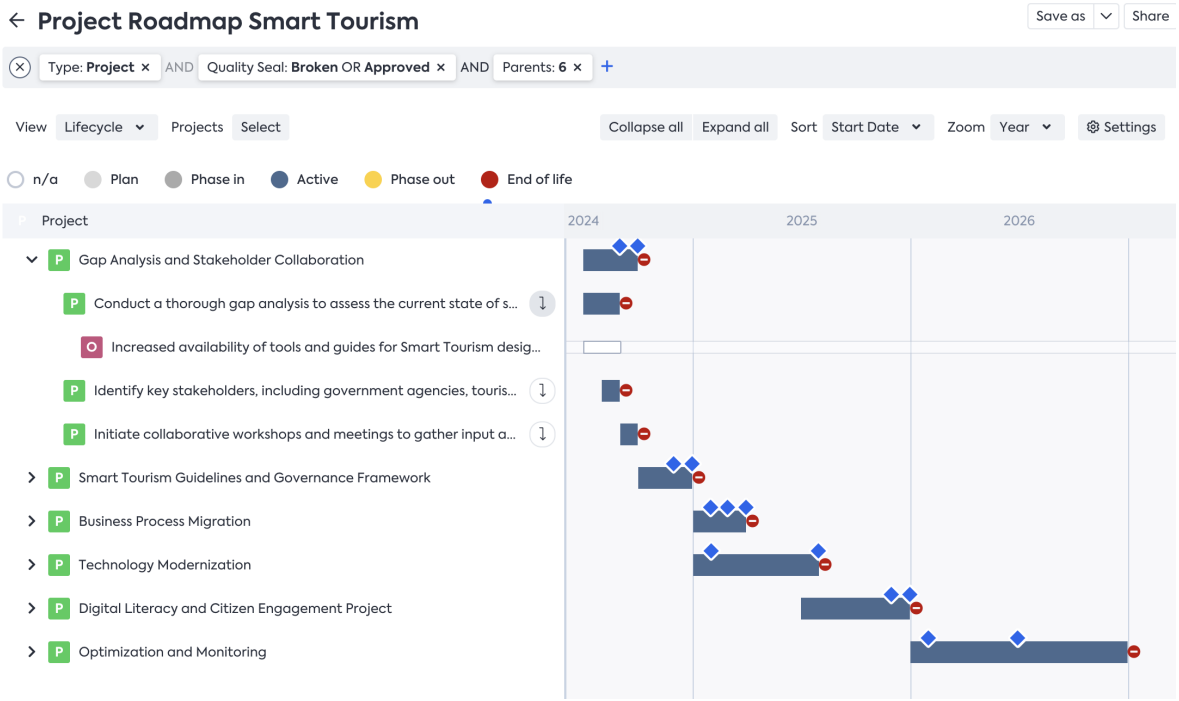

Figure 4.20: LeanIX Project Roadmap

The Roadmap Report is a dynamic communication tool, facilitating clear and effective dissemination of the organization's vision and strategic plans to diverse stakeholders. This group includes IT leaders, business executives, and other pertinent parties involved in decision-making. One of the key features of the Roadmap Report is its ability to visually track and display various projects, objectives, and goals. Each element within the roadmap is typically linked to specific business objectives or IT capabilities, providing a clear and structured representation of how each initiative contributes to the organization's overarching strategy. The Roadmap Report in LeanIX EAM represents a comprehensive and strategic tool integral to the planning, communicating, and executing an organization's enterprise architecture journey.

Several work packages can be translated as deliverables based on the migration viewpoint. Thus, that deliverable translated as a milestone in each project in the project roadmap in LeanIX. The six steps encompass discovery, preparation, exploration, realization, optimization, and monitoring. Initially, it focuses on identifying gaps in smart tourism, fostering stakeholder collaboration, and formulating guidelines and governance frameworks. LeanIX plays a crucial role in documenting existing architectures and facilitating stakeholder engagement. Subsequently, the model emphasizes transforming business processes, streamlining applications, and modernizing technologies, with LeanIX aiding in business capability mapping and technology assessment. The concluding phases prioritize the continuous optimization of the smart tourism platform, enhancing digital literacy, improving citizen participation, and utilizing LeanIX for performance monitoring, improvement management, and feedback integration, thereby ensuring an efficient and effective smart tourism ecosystem.

4.6 Elements of Developing Countries in the Reference Architecture

Based on Chapter 3 of the reference architecture and the solution architecture in Chapter 4 adjusted for the Pontianak Smart City Initiative, insights regarding developing countries for smart tourism are revealed in this section. Several patterns are discovered within the case study, which requires further study in different case studies of developing countries to include these as the characteristics of developing countries. Compared with the reference architecture proposed in Chapter 3, there is no big difference in the standard for smart tourism in developing countries compared to developed countries. However, some aspects need to be considered to ensure a good implementation of smart tourism.

Government Priorities

Developing countries may have different economic priorities and challenges. Based on the study of Pontianak Smart City, the main goal is to increase the city's brand value through technology. In addition, the sub-goals are focused on how to realize application in the manual process within the government. The smart city team's testimony is that the city's main domain is tourism because that is the central income of the city's economy. Finally, based on the Pontianak Smart City plan study, priorities revolve around good governance, brand value, economic growth, digital literacy, safe living, and environmental management. Furthermore, the uniqueness of the goal of Pontianak City is incorporating social factors into the goals, which is realizing religious, cultured, and civilized citizens in the city. Developing countries have unique social and cultural landscapes. The plan should consider how it aligns with local customs, practices, and societal norms.

Business and Technology Alignment

In continuation of the previous section, some sub-goals are centralized around how to realize applications in the smart city process. The Pontianak Smart City team does not have a team or a role that focuses on creating enterprise architecture that aligns with the business and technology goals. Currently, the plan only involves technology architecture to support the infrastructures of the technology in the project. However, based on the smart city plan they provided, there needs to be a clear-cut definition of how the technology supports the business goals. Therefore, in order to realize smart tourism, there is a need to introduce enterprise architecture knowledge within the smart city team in developing countries. Improving resources, especially in the human resource aspect, is essential.

Resource Constraints

Developing countries often need more resources, such as funding, technology, and skilled personnel. This is supported by two-thirds of the respondents from the smart city team, who say that resource constraints are the challenge they face in implementing a good technology infrastructure for smart tourism. Additionally, the architecture likely accounts for the varying levels of digital literacy among its user base, offering intuitive interfaces and user experiences that do not assume advanced technical knowledge. This characteristic is crucial to ensure the broad accessibility and usability of smart tourism applications, making them more inclusive for all potential users, including local stakeholders, tourists, and government entities.

Technological Infrastructure

The varying levels of technological infrastructure in developing countries should be a consideration. In the realm of smart tourism, especially within the framework designed for emerging economies, an aspect is its strategic alignment with the technological landscape prevalent in these regions. This involves crafting resource-conscious solutions tailored to environments where digital infrastructure might be evolving and highly accessible. The architecture prioritizes efficient systems in low-bandwidth scenarios, ensuring functionality even in areas where internet service may be limited in speed and reliability.

Isolated Business Process

In the development of smart tourism operations in the city, silos business operations are widely found in the organization. Within the case study, each government's department of stakeholders has a business process that needs to be more seamlessly integrated. When introducing smart tourism practices in developing countries, the main focus should be improving good governance. The lack of internal coordination will hinder the government from acting as a guide and resource allocator in the smart tourism ecosystem. The role of government in developing countries and existing policy frameworks should be considered, as these can significantly impact the implementation of smart tourism strategies.

Chapter 5

Validation of Reference Architecture with Case Study

This chapter explores the outcomes of implementing the reference architecture in a case study, the smart tourism initiative in Pontianak City, Indonesia. The methodology involves introducing the specifically aligned enterprise architecture management software to stakeholders within the chosen case study context. This approach enables these stakeholders to assess and verify the architecture's applicability in a real-world scenario. Such an examination is a crucial part of the treatment validation phase within the design science engineering cycle. In this particular research, the method employed is the Single-Case Mechanism Experiment, aimed at evaluating the effectiveness of the validation model when applied to a singular object of study. The validation model comprises the architecture within a simulated environment reflecting the developing countries' conditions.

Accurately measuring this validation model's performance emphasizes the importance of clearly defining measurement variables. In alignment with the objective of this thesis, which is to realize smart tourism reference architecture in a developing country, the validation process from the stakeholders' perspective involves assessing how well the proposed solution architecture meets the established requirements. These requirements are outlined in the Architectural Requirement from Table 3.1 of the reference architecture. Consequently, a series of hypotheses are presented in the subsequent section. These hypotheses are intended to test whether the anticipated effects, as outlined in the reference architecture, are indeed observable and acknowledged by the stakeholders in the context of the Smart Tourism Project, Pontianak City, Indonesia.

5.1 Measurement Design

This study implements a qualitative methodology to evaluate the hypotheses of the validation model, analyzing data collected from interviews with stakeholders involved in the project. The stakeholders involved are five people, who consist of practitioners and academic participants. Practitioners include people from the government who are involved in the Smart City project. Thus, the academic participants are people with expertise in enterprise architecture at the university. The interview methods involve an architectural presentation, and stakeholders are engaged in interviews. This format ensures consistency across interviews, granting participants the space to provide detailed responses and allowing the researcher to research deeper with follow-up inquiries. This Table also serves as a questionnaire, facilitating the assessment of stakeholders' perceptions of the proposed reference architecture in satisfying the requirements and its impact on reducing entry barriers for rural businesses in the collaborative ecosystem.

5.1.1 Validation Questions

The initial stage of the validation process focuses on evaluating how effectively the proposed reference architecture fulfills the specific common requirements outlined in the Requirement Analysis in Table 3.1, Chapter 3. This evaluation is important in determining the degree to which the proposed architecture aligns with these predefined requirements.

First Question: How well does the proposed architecture visualize digitalizing business processes in the smart tourism sector? [Q1]

Based on the requirement analysis in Table 3.1 and motivation in Figure 3.2 in Chapter 3, this question is crafted. One of the prominent motivations is efficiency. Enhancing resource utilization efficiency via the strategic deployment of appropriate technologies is essential, as is maintaining the overall quality of services by integrating innovative digital service processes (Roopchund, 2020). As visualized in the proposed reference architecture for smart tourism organization viewpoint, the government plays a huge role as a resource allocator. Based on the experts' interviews in the data collection phase, the government needs more resources to execute smart city plans. Therefore, increasing the efficiency of digital government services is needed. Efficiency is gained with the support of technology mediation (Vecchio et al., 2018). The proposed digitalization should offer a transformation of manual and silo business processes of smart tourism to be integrated.

Second Question: How well does the proposed architecture visualize each stakeholder's marketing business process to realize collaboration? [Q2]

This question is designed according to the requirement analysis in Table 3.1 in Chapter 3. In addition, based on the Pontianak Smart City plan, the big goal of smart tourism is to increase city branding through the local uniqueness of the city (Mayor of Pontianak City, 2019). Thus, co-marketing between stakeholders is needed to realize optimum tourism marketing activities (Chuang, 2023). However, as illustrated in the baseline of business cooperation viewpoint, there is a gap that the stakeholders are currently isolated when promoting tourism. Therefore, this proposed reference architecture should provide integrated tourism marketing activities between stakeholders.

Third Question: How well does the proposed architecture visualize the enablement of smart tourism applications and IoT technology at the tourism site? [Q3]

Based on the requirement analysis in Table 3.1 and motivation in Figure 3.2 in Chapter 3, this question is crafted. Improvements in the government's decision-making process can be realized through data processing (Vecchio et al., 2018) However, there is a gap in the process of data acquisition and processing by the government that leads to silos process. As proposed in Figure 3.10, IoT technology usage viewpoint, on-site tourism IoT technology interoperability is needed. The collective data formulated on each spot

will give valuable data to the smart city initiative. Thus, creating smart cities requires increased collaborative efforts beyond government to include the private sector, leveraging Internet of Things (IoT) technologies to quicken their development (Salvendy & Wei, 2022) Therefore, the proposed reference architecture should visualize the IoT application usage enablement in the smart tourism.

Fourth Question: How well does the proposed architecture provide standardized guidelines to facilitate the collaboration of the smart tourism ecosystem? [Q4]

This question is crafted based on the motivation in Figure 3.2 in Chapter 3. In addition, it is extracted from the requirement analysis in Table 3.1, which proposes a standardized guideline for smart tourism. However, the integration between stakeholders needs to be improved. This ecosystem collaboration needs extra attention because it is a high-priority aspect of achieving economic and environmental sustainability (Rouhani et al., 2015b). As proposed in the smart tourism realization viewpoint in Figure 3.6, the standard business process of each stakeholder has been defined to realize the smart tourism service. Therefore, the proposed architecture should be able to provide standardized guidelines to facilitate the collaboration of the smart tourism ecosystem.

Fifth Question: How well does the proposed architecture enable and support the stakeholders to operate smart tourism effectively? [Q5]

This hypothesis is crafted from the Figure's motivation viewpoint in the previous section, managing the government's resources efficiently and proposing a strategy to enable the stakeholders to operate smart tourism from the requirement analysis in Table 3.1. As mentioned in the previous section, resources are one of the main barriers to the government's realizing smart tourism. A strategy to enable smart tourism needs to be realized. Therefore, the proposed reference architecture should help the stakeholders to allocate resources efficiently.

Sixth Question: To what extent does the LeanIX software reflect the ArchiMate reference architecture and help to manage the Smart Tourism strategy? [Q6]

Chapter 4 of my thesis investigates the integration of the ArchiMate reference architecture within the LeanIX Enterprise Architecture Management software. This essential integration is a key focus of this sub-section, demonstrating how ArchiMate's theoretical models can be effectively implemented in the practical environment provided by LeanIX. It offers stakeholders a robust framework for managing and optimizing their enterprise architecture, aligning it closely with implementing smart tourism strategies, which are increasingly vital in today's fast-evolving tourism industry.

Consequently, this validation question aims to explore how LeanIX software reflects the ArchiMate reference architecture and aids in managing smart tourism strategies. This question is aimed at critically examining how well LeanIX reflects the principles

and structure of the ArchiMate framework and determining its effectiveness as a tool in operationalizing smart tourism strategies. This analysis assesses LeanIX's practical utility in transforming theoretical architectural concepts into tangible strategies that can be effectively executed within smart tourism.

Seventh Question: To what extent does this reference architecture support the tourism competitiveness of developing countries? [Q7]

The initial chapters establish a solid theoretical ground through an extensive review of scientific literature, highlighting the key role of smart tourism in promoting competitiveness. This exploration underscores the significance of smart tourism in increasing a competitive advantage within the tourism industry. Advancing this narrative, Chapter 4 enriches these insights with a practical case study, illustrating the application of these principles. The case study aligned with the Pontianak Smart City Plan; smart tourism aims to achieve competitiveness or enhance brand value in the tourism sector, particularly in developing countries.

Thus, the validation question that arises in Chapter 4, and one that ties together the theoretical and practical aspects of this thesis, is centered on the effectiveness of the reference architecture in supporting the competitive landscape of the tourism industry in developing countries. The validation question implemented is: "To what extent does this reference architecture support the tourism competitiveness of developing countries?" This question aims to evaluate the real-world impact and perspective of the stakeholders to the reference architecture in enhancing the tourism sector's competitiveness, providing a comprehensive analysis of the intersection between smart tourism practices and competitive advancement in these regions.

Therefore, a Likert Scale ranging from 1 to 5 is employed to quantify the stakeholders' approval levels, with '1' indicating unmet requirements and '5' indicating full approval. This scale assists in quantifying the average satisfaction level with the proposed reference architecture and the variance in stakeholders' opinions via standard deviation. Additionally, two separate columns for positive and negative feedback are included to capture the depth of stakeholders' viewpoints. Individual scores are averaged when analyzing responses, and the collective findings are interpreted within their respective interval ranges, providing an understanding of stakeholders' approval and feedback. Interview questions are crafted to align with the established requirements outlined in the following section.

5.2 Analysis and Result

The validation of interview outcomes begins with an analysis of responses to the questionnaire. Afterward, this section elaborates on the result of the semi-structured interviews conducted with academics and practitioners to measure the balance of their perspectives on this research.

Respondents were asked to express their views on the proposed architecture in the interview process to validate the hypotheses. Appendix B provides the complete transcripts of these responses for comprehensive reference. This approach ensures a thorough understanding of the stakeholders' perspectives on the proposed reference architecture and its alignment with the project's objectives. Afterward, the questionnaire emphasizes the average (mean) scores, reflecting the overall trend and the standard deviation, highlighting participant response variations. As presented in Table 5.1, the mean scores for each question vary between 3,8 to 4,4. The lowest average values are noted for Q3, while Q1, Q2, and Q6 exhibit the highest averages.

Regarding standard deviation, values range from 0,55 to 0,89. In this context, a standard deviation of zero typically signifies unanimous agreement among respondents, whereas values above 1 suggest significant variation in responses. Therefore, the standard deviation range obtained here suggests a moderate consensus among academics and practitioner participants regarding their satisfaction with the requirements depending on the question. The result of the questionnaire is shown in Table 5.1 below.

Table 5.1: Validation Results

No.	Questions	1st	2nd	3rd	4th	5th	6th	Average	Standard Deviation
1.	How well does the proposed architecture visualize digitalizing business processes in the smart tourism sector?	5	4	4	4	5	4	4,3	0,52
2.	How well does the proposed architecture visualize each stakeholder's marketing business process to realize collaboration?	5	5	3	4	5	5	4,5	0,84
3.	How well does the proposed architecture visualize the enablement of smart tourism applications and IoT technology at the tourism site?	5	4	3	3	4	4	3,8	0,75
4.	How well does the proposed architecture provide standardized guidelines to facilitate the collaboration of the smart tourism ecosystem?	5	4	3	4	5	5	4,3	0,82
5.	How well does the proposed architecture enable and support the stakeholders to operate smart tourism effectively?	5	4	3	4	4	5	4,2	0,75
6.	To what extent does the LeanIX software reflect the ArchiMate reference architecture and help to manage the Smart Tourism strategy?	5	4	4	4	5	5	4,5	0,55
7.	To what extent does this reference architecture support the tourism competitiveness of developing countries?	5	4	3	4	5	5	4,3	0,82
Average								4,29	
Standard Deviation								0,72	

First Question: How well does the proposed architecture visualize digitalizing business processes in the smart tourism sector? [Q1]

It is acknowledged that some tourism processes still need technology interoperability to enhance the digitalization of the smart tourism business process, leading the Smart

City program. The 2nd Participant, who is involved in the smart tourism project as the integration provider, expressed that the interoperability between tourism applications will support the smart tourism business process. The data exchanged between the government and external tourism applications will enrich the tourism experience. This perspective was supported by 1st Participant, representing the government, who viewed the proposed architecture as a way to showcase and promote tourism's local uniqueness to the tourists, thus optimizing their tourism competitiveness. She expressed confidence that smart tourism could streamline the digitalization process for these projects, which is crucial to achieving the objective of smart tourism. In addition, the 6th Participant, an enterprise architect academic, supports the statement. The proposed architecture is already commendable and can facilitate the digitalization of smart tourism business processes, especially in the case of smart tourism in Indonesia as a developing country. As a developing country, Indonesia still needs to establish an integrated platform among stakeholders, particularly from the tourism industry and local government.

However, a challenge identified is the limited adoption of technology among citizens; one of the reasons is the need for digital literacy. 1st Participant elaborated that there are several government programs to raise the citizens' awareness to increase digital literacy. One of the projects is "Bimbingan Teknis di bidang Teknologi Informasi dan Komunikasi (TIK)", is an activity within the framework of capacity building for Youth, Business Actors, Teachers, Gender Responsive People, and People with Disabilities with training topics in the form of Website Technology, Networking Computers, Applications, and Content. Thus, the program will aid the digitalization process proposed in the architecture of this research.

In conclusion, all respondents who participated in the validation agreed that the proposed architecture would aid in the digitalizing of the smart tourism process. This consensus is further validated by an average score of 4.3 with a standard deviation of 0.52 in the responses, indicating minimal variance in their opinions.

Second Question: How well does the proposed architecture visualize each stakeholder's marketing business process to realize collaboration? [Q2]

Respondents who participated in the validation agreed that the proposed architecture would support the visualization of each stakeholder for the cooperation of the marketing business process. This consensus is further validated by an average score of 4.5 with a standard deviation of 0.84 in the responses, indicating different participant opinions. The practitioner believes that the project to collaborate between the government and related providers must be realized, and the proposed solution is sufficient to be realized in the current condition. On the other hand, the academic participant believes that the architecture should be extended to visualize more business functions within after-trip services in the architecture, such as incorporating tourist reviews for a loop of improvement. However, the other academic participant said the proposed business process architecture is already comprehensive and streamlined. However, it ensures that the required changes are manageable from the current condition. Thus, to adjust to developing countries' resources, we need to ensure the practicality of the artifact.

Third Question: How well does the proposed architecture visualize the enablement of smart tourism applications and IoT technology at the tourism site? [Q3]

In the validation stage, respondents agreed that the proposed architecture would moderately assist in visualizing the enablement of smart tourism applications and IoT technology at the tourism site. This consensus is further validated by an average score of 3.8 with a standard deviation of 0.75 in the responses, suggesting differing opinions between respondents. The practitioners believe the proposed solution would help them manage the plan to involve more IoT technologies because they have yet to utilize them. However, the academic participant believes more exploration is needed to define the technologies. IoT in the Indonesian context still requires further study due to limitations in Internet connectivity and even electricity in some underdeveloped areas. Nevertheless, the current proposed architecture can serve as a suggestion for developers in designing and implementing the technological solution.

Addressing the complexities of IoT integration within the framework of smart tourism in places like Indonesia reveals a complex landscape of challenges across technical, strategic, and social landscapes. The feedback from design validators, pointing to a realization of IoT's potential due to infrastructural limitations and societal concerns, calls for an extensive exploration beyond the current implementation boundaries. This scenario is illustrated by the difficulties encountered in areas with limited internet connectivity and electricity, alongside the observed societal pushback, including vandalism, which requires a more tailored approach. It calls for a strategy outlining IoT technologies' specific roles and infrastructure needs within smart tourism, ensuring alignment with the goals of enhancing tourism experiences and operational efficiencies.

Fourth Question: How well does the proposed architecture provide standardized guidelines to facilitate the collaboration of the smart tourism ecosystem? [Q4]

Regarding the fourth validation question, the practitioner and academic participants who participated in the validation agreed that the proposed architecture would aid in providing standardized guidelines to facilitate the collaboration of the smart tourism ecosystem. This consensus is further validated by an average score of 4.3 with a standard deviation of 0.82 in the responses. The widespread opinion about this requirement comes from the practitioners who believe it will be a good guideline for them. Furthermore, it should be well published throughout the town to the stakeholders through interactive advertising. However, the academic participants believe that for some audiences with less context, this viewpoint can be quite ambiguous to understand.

Fifth Question: How well does the proposed architecture enable and support the stakeholders to operate smart tourism effectively? [Q5]

Respondents who participated in the validation approved that the proposed architecture would aid in enabling and supporting the stakeholders to operate smart tourism effec-

tively. This consensus is further validated by an average score of 4.2 with a standard deviation of 0.75 in the responses. The practitioner said that the proposed solution aligns with the strategy of their project, and he believes that it will create a good tourist experience within the city. However, the academic participant recommends involving third-party providers to be more sustainable in running the operation and the development.

Sixth Question: To what extent does the LeanIX software reflect the ArchiMate reference architecture and help to manage the Smart Tourism strategy? [Q6]

Regarding the proposed solution architecture to LeanIX software, all respondents who participated in the validation agreed that the LeanIX software reflects the ArchiMate reference architecture and helps to manage the Smart Tourism strategy. This consensus is further validated by an average score of 4.5 with a standard deviation of 0.55 in the responses, indicating minimal variance in their opinions. The practitioner said that this reference architecture is a good solution to realize smart tourism practices that support tourism competitiveness for our city. Currently, we need more coordination between the department and stakeholders. This mapping helps us better understand how to manage enterprise architecture in our daily operations.

Moreover, the academic enterprise architect expert said that using LeanIX is very relevant and needed by governments in developing countries, especially in ensuring that the procurement of platforms is aligned with the designed enterprise architecture.

Seventh Question: To what extent does this reference architecture support the tourism competitiveness of developing countries? [Q7]

To measure the project's overall goal of improving tourism competitiveness, respondents who participated in the validation agreed that the proposed architecture would aid in reference architecture to support the tourism competitiveness of developing countries. This consensus is further validated by an average score of 4.3 with a standard deviation of 0.82 in the responses, indicating a difference in their point of view. The practitioner involved in the smart city project believes that the architecture can realize coordination between the government to integrate applications supporting each tourism site's promotion. However, the academic participant stated that it needs to be instantiated by demonstrating a set of platforms in the smart tourism ecosystem to understand its supporting capability better. Therefore, that suggestion is the limitation of this research and becomes the recommendation for further research direction in this thesis.

Chapter 6

Conclusion

This chapter discusses the main and sub-research questions proposed in the first chapter. Afterward, conclude all of the insights found within this research. Subsequently, elaborate on the limitation and propose future research regarding the main topic of this thesis.

6.1 Research Questions

This research has answered the main research question of improving smart tourism practices for developing countries by designing a reference architecture that supports tourism competitiveness. It is answered in Chapter 3 as the reference architecture is crafted for smart tourism, Chapter 4 as the solution architecture is tailored specifically for the case study, and Chapter 5 as the validation of the solution, whether it fulfills the requirements or not. Therefore, the following sections discuss how the sub-research questions are answered.

SQ1: What is state of the art on Smart Tourism enterprise architectures?

The initial sub-research question in my study focused on exploring the theoretical foundations of Smart Tourism practices. This exploration began with a systematic literature review, which studied information about knowledge and practices in this field. The findings from the systematic literature review can be found in Chapter 2.

SQ2:What is a suitable enterprise architecture based on the reference architecture to conduct the development of smart tourism in developing countries?

The second sub-research question focused on a suitable enterprise architecture based on the reference architecture to conduct the development of smart tourism in developing countries. Chapter 3 outlines the conceptual framework and prerequisites for constructing this model, detailing the essential elements and considerations for formulating an effective strategy. The ArchiMate modeling language, employed within an enterprise architecture context, was instrumental in designing this reference model. Afterward, Chapter 4 delved into the practical application of the smart tourism architecture adjusted to the case study in Pontianak Smart City, Indonesia. The solution architecture was conducted using the ArchiMate modeling language, a widely known academic field of enterprise architecture. In addition, it is aligned with LeanIX as the enterprise architecture management widely used in the industry. These two solutions balance academic and practitioner perspectives for this project. This chapter offered an in-depth analysis of the current situation, target objectives, gap analysis, and the actionable steps required for the strategic implementation within the specified context.

SQ3: To what extent does the Indonesian Local Government, as a case study, align with the proposed smart tourism platform reference architecture?

The third sub-research question focused on gathering expert opinions on the proposed reference architecture. Chapter 5 discusses the valuable insights obtained from expert evaluations, which served to validate the model. This validation was achieved through one-on-one interviews and an online questionnaire with industry experts involved in the Smart City projects and academics who are experts in enterprise architecture.

This research thoroughly addresses the main research question and related sub-questions, adopting a comprehensive approach to enhance smart tourism practices in developing countries. The findings presented in each chapter collectively contribute significant insights, aiding the improvement of tourism competitiveness through smart tourism practices.

6.2 Research Conclusion

This thesis has effectively developed and validated a Smart Tourism Reference Architecture tailored for Developing Countries, focusing on integrating smart tourism practices in these contexts. The research sheds light on the importance of enterprise architecture in boosting tourism competitiveness and provides a thorough framework for designing and executing smart tourism initiatives.

The journey of this research began with an in-depth literature review in Chapter 2, examining the latest studies in Smart Tourism enterprise architectures. The study then evolved in Chapter 3, assessing the applicability of enterprise architecture in the development of smart tourism. This chapter was essential, establishing a conceptual framework and identifying the essential components for developing a successful smart tourism strategy utilizing the ArchiMate modeling language. The practical deployment of this architecture, particularly in Pontianak Smart City, Indonesia, was explored in Chapter 4. This chapter bridged the gap between theory and practice, showing how the ArchiMate and LeanIX models can be effectively applied and tailored to a specific case study. It provided a comprehensive view of the current scenario, future goals, a gap analysis, and strategic steps for implementation, matching scholarly detail with practical relevance. The pivotal Chapter 5 involved validating the proposed architecture through expert insights and assessments. This process, involving interviews and questionnaires with industry professionals and academics, affirmed the architecture's effectiveness and relevance. It highlighted its suitability for the needs and expectations of the Indonesian Local Government, validating its practical utility and effectiveness in a real-world scenario.

Reflecting on the insights from the design validators regarding the proposed smart tourism architecture for Indonesia, it becomes evident that the approach has key strengths that earn distinction. These strengths are instrumental in pushing forward the digital transformation agenda within a developing country's tourism sector. They include the digitalization of tourism business processes, the enhancement of tourism marketing

strategies, and the strategic deployment of LeanIX software alongside the ArchiMate reference framework to navigate smart tourism initiatives.

Firstly, the architecture's capability to modernize and digitize the operational frameworks of tourism businesses stands out as a key advancement. In Indonesia, where a cohesive digital platform connecting the various tourism stakeholders and government entities is yet to be fully realized, the proposed model offers a blueprint for integration. It carefully balances the initiative for digital innovation with the practical need to build on existing operational foundations, ensuring the transition is achievable and impactful. Moreover, the emphasis on marketing tourism destinations through digital channels within the architecture addresses a critical need for visibility and engagement in today's competitive tourism market. This strategic focus is designed to promote Indonesia's tourism as a premier destination by leveraging digital tools to showcase its unique cultural and natural offerings, aiming to draw a wider audience and stimulate local economies. Lastly, integrating LeanIX software to reflect the principles of the ArchiMate reference architecture in managing the smart tourism framework illustrates a refined approach to strategy execution. LeanIX is adaptable in facilitating the strategic alignment of IT systems with broader business objectives, ensuring that the smart tourism initiative's technological underpinnings are robust and adaptable. This application of LeanIX, in harmony with ArchiMate's modeling standards, provides a solid foundation for the initiative's ongoing development, scalability, and success.

The lowest point acquired in the design validation phase conducted by six experts is the visualization of IoT usage in smart tourism. The experts believe further study focused on IoT usage in smart tourism operations is necessary because of some limitations. In developing countries, there are limited technology resources, such as connectivity, in some areas. Furthermore, based on the case study, insight reveals several acts of vandalism by citizens to the IoT technologies that the government provides in the city.

The architecture presents a forward-looking and strategically grounded blueprint for advancing smart tourism in Indonesia. Addressing the digitalization of business processes, enhancing marketing efforts, and employing a structured management approach through LeanIX and ArchiMate sets a comprehensive path toward transforming Indonesia's tourism sector into a more connected, efficient, and competitive landscape. In response to the lowest point, the plan should identify adaptable and resilient IoT solutions that are mindful of the local infrastructural realities and cultivate a plan where technological advancements are accepted and embraced. Future explorations to utilize IoT technologies for the broader community while highlighting their tangible benefits are necessary. By adopting such a comprehensive and inclusive approach, the research to enrich smart tourism in developing contexts with IoT can evolve from concept to reality, enabling environments where technology serves as a bridge to a more sustainable, efficient, and inclusive tourism future relevant to the aspirations and realities of destinations like Indonesia.

The exploration of the smart tourism initiative in Pontianak, as a representation of developing countries, brings insights into the distinct challenges and strategic needs of these environments. The findings reveal that while the benchmarks for smart tourism remain uniform across different economic landscapes, there is a pressing need for adapta-

tions created specifically for resource limitations, digital infrastructure differences, and socio-economic contexts in developing countries. The initiative emphasizes aligning government objectives with the broader goal of economic enhancement and social well-being, highlighting the need for a cohesive enterprise architecture that bridges technology and business goals. The study points out the essential conditions for innovative solutions according to their user base's digital literacy levels, ensuring that smart tourism platforms are accessible and user-friendly across diverse demographics. It also stresses the importance of seamless integration within governmental processes to promote efficient governance and facilitate a unified approach to smart tourism development. This case study illustrates the unique considerations for deploying smart tourism strategies in less developed regions and outlines the importance of a comprehensive strategy that incorporates stakeholder collaboration, adaptive planning, and the deployment of context-aware technologies to achieve the objectives of smart tourism in developing countries effectively.

The research thoroughly addressed the main research question and its associated sub-questions within those chapters. The insights gained at each study stage significantly contribute to advancing smart tourism practices in developing countries. This research drives the theoretical understanding of smart tourism forward and provides practical insights and strategies, enhancing tourism competitiveness through innovative and sustainable tourism practices.

6.3 Contributions

This research makes significant contributions both academically and practically.

6.3.1 Academic Contributions:

Academically, its value lies in its novel approach to studying the complexities of smart tourism strategies, especially in developing countries. This study's use of the ArchiMate modeling language to develop a reference architecture for smart tourism practices enhances the theoretical academic landscape in tourism management and the smart city domain. It uses a real-world case study set in a specific geographic situation and primary data collection to enrich academic discourse by providing empirical evidence and offering new practical perspectives. This research also lays down a structured and systematic framework for future academic research in similar contexts, paving the way for better smart tourism practices in developing countries. The full ArchiMate files can be accessed through this link: https://github.com/dimasapry/ArchiSmartTourismRA.

6.3.2 Practical Contributions:

From a practical standpoint, this study addresses the challenges of smart tourism practices in developing countries through LeanIX's Enterprise Architecture Management (EAM). The primary data, gathered through fieldwork in Pontianak City, West Kalimantan Province, Indonesia, yields essential insights into the smart tourism practices of

developing countries. The study goes beyond theoretical analysis to propose practical recommendations through a well-structured reference model. This model is designed to be both practical and actionable. Smart tourism project officers are able to optimize and monitor the proposed reference architecture in their daily operations with the stakeholders through the EAM. It offers clear guidelines and important considerations for implementing smart tourism strategies in similar environments.

6.4 Limitations and Future Research

Recognizing the limitations encountered in this research study is essential, as it lays the groundwork for the potential research direction of future investigation. The following points outline these limitations and recommendations that future research could beneficially explore:

6.4.1 Limitations

This research has identified several limitations that pave the way for future research directions. A primary limitation was the limited number of respondents involved in validating the architecture. This resulted in a constrained range of perspectives about the proposed reference architecture, particularly from smart tourism ecosystem stakeholders. Their insights are especially crucial in refining the proposed business processes for practical implementation in real-world scenarios. Further input from these stakeholders would also inform us to transition from a silo business process to an integrated tourism business process. Due to the complex range of stakeholders and limited time and resources, not all stakeholders can participate in this research. Another constraint was the time available for conducting this research, which inevitably affected the scope of the study, particularly in developing the proposed architecture. This research primarily focuses on building the reference architecture for smart tourism practices through an enterprise architecture model.

While this study focuses on overarching smart tourism strategies, including business models, there needs to be more in-depth exploration, particularly regarding the dynamic social aspects and technical details. The building of the actual concrete components of the proposed application and technology has yet to be realized in this thesis. The final limitation stated in this research concerns validating the case study in different cities in Indonesia or other developing countries. This could mean examining the effects of implementing the reference architecture in different provinces or countries with varying cultures and societal priorities.

6.4.2 Future Research Directions

Future research directions are recommended in the following areas, expanding upon the findings of this study:

1. **Extending the Design Cycle Steps from this Research:** This research primarily covers three stages of Wieringa's (2014) design cycle: problem investigation, treatment design, and treatment validation. However, it does not extend into the treatment implementation phase and the subsequent evaluation of this implementation. Future studies could include these phases to provide a more complete understanding of the lifecycle of smart tourism in practical settings.

2. **Concrete Implementation of Smart Tourism Application:** There is a need to transition from the abstract theoretical models of technical components to tangible applications in real-world projects or scenarios. There needs to be more depth of exploration, particularly regarding technical details. Future research could delve deeper into these areas to enhance the precision and comprehensiveness of the reference model. This would involve practical implementation and adaptation in diverse settings.

3. **Expanding Validation to Other Developing Countries to Ensure the Reference Architecture Validity to the Developing Countries:** Further research in another case study is essential to prove whether the reference architecture is generic to the developing countries. The effectiveness of the smart tourism strategy is influenced by several factors, such as business, technical, and social contexts in which they are implemented. Future research should validate the approach through diverse case studies encompassing various geographical and operational environments. The future case study could be a different city in Indonesia or other cities in other developing countries.

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Appendix A

Data Collection

Data Collection - Interview Updates

Researcher: Dimas Apriyandi

No	Interview Time (CEST)	Position	Institution	Location	Status
1	7 September 2023 (10:00-11:00)	Head of Division	Pontianak City Government (Department of Communication and Information)	Pontianak	Finished
2	30 October 2023 (07:00-07:41)	Data Center Manager	Pontianak City Government (Department of Communication and Information)	Pontianak	Finished
3	30 October 2023 (08:00-08:30)	Programmer	Pontianak City Government (Department of Communication and Information)	Pontianak	Finished
4	30 October 2023 (13:00-13:30)	Programmer	Pontianak City Government (Department of Communication and Information)	Pontianak	Finished
5	5 September 2023 (13:00-13:30)	Head of Department	Pontianak City Government (Department of Youth, Sports and Tourism)	Pontianak	Finished

Data Collection Interview Lists

Topics	Target Data	Questions	Key Informants of Pontianak City Government				
			Department of Communication and Information				Department of Youth, Sports and Tourism
			Head of Division	Data Resource Manager	Programmer	Programmer	Head of Department
Organizational	Business Role	What is the team size in the smart city project, especially in the tourism domain?	√	√	√	√	
		What is job descriptions for each team?	√	√	√	√	√
		What is your role in this project?	√	√	√	√	√
	Business Process	What is the tourism business process in the department?					√
	Stakeholder	Who is the stakeholder related to smart city in the tourism domain?	√	√	√	√	√
Motivation	Motivation	What is your team's target for this project?	√	√	√	√	√
	Challenge	Do you face any challenges while doing this project?	√	√	√	√	√
Enterprise Architecture (EA)	EA Role	Are you involved in the making of Enterprise Architecture? If yes, how long have you been working with Enterprise Architecture?	√	√	√	√	
	Existing EA	Is your company implementing an RA/reference framework in the work with enterprise architecture? If yes, what is the name of the Enterprise Architecture and RA?	√	√	√	√	
	EA Tool	What tools are being used for the development and communication of the Enterprise Architecture?	√	√	√	√	

	EA Requirement	What requirements are there on the structure of the enterprise architecture and Enterprise Architecture?	√	√	√	√	
	EA Implementation	Is your architecture extensible? Are there plans for continuous improvement, or was it a one-off effort?	√	√	√	√	
Future Recommendation	Ideal Project	Is such a project feasible?	√	√	√	√	
	Ideal Improvement	How successful were you in your endeavors? How did management/users receive the solution?	√	√	√	√	

Appendix B

Interview Transcripts

No.	Questions	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
1.	How well does the proposed architecture visualize digitalizing business processes in the smart tourism sector?	This solution is very good. It helps me, as the project manager, to coordinate the digital government service to realize the smart tourism project.	In the long term, this process digitalization scheme is possible	It is able to serve as the target landscape where the government, developer, and solution provider can refer to before, during and after the digitalization journey	The idea is good: to comprehensively cover all stages of tourism stages.	The proposed solution is pretty good, but we must consider the government personnel's technology readiness.	The proposed architecture is already quite commendable and is capable of facilitating the digitalization process of smart tourism business processes, especially for the case of smart tourism in Indonesia as a developing country. As a developing nation, Indonesia has not yet established an integrated platform among stakeholders, particularly from the tourism industry and local government.
2.	How well does the proposed architecture visualize each stakeholder's marketing business process to realize collaboration?	Coordination between stakeholders is essential to realizing proper marketing activities for tourism sites.	That is a very good idea. The project to collaborate between the government and related providers must be realized. Of course, it is supported by a mutually beneficial MoU (agreement).	I can imagine that in the part of after-trip services, there can be many more beneficial functions for tourism's sustainability. E.g., incorporating tourist reviews as a feedback loop for improvements, promoting advertisements and other related offerings relevant to the tourists, etc.	Measured as good. But I am not sure what it means by co-creation.	The current situation fails to map the business process accordingly, which helps us realize the missing process of the government.	The proposed business process architecture is already quite comprehensive and streamlined, yet it ensures that the required changes are not too significant from the current condition.
3.	How well does the proposed architecture visualize the enablement of smart tourism applications and IoT technology at the tourism site?	This solution helps us to know the technology architecture to realize IoT technologies in the future.	Good suggestion. In my opinion, this architecture can be implemented by considering the readiness of the Government of the Department of Communication to accommodate services and supported by collaboration with the teams concerned.	It can serve as a suggestion for developers in designing and implementing the technological solution. Though, it is still questionable for the technological decision to use a specific/certain communication protocol and not incorporating other of protocols as well.	Measured as average. However, technology services provided by the IoT is unclear for me.	For now, we don't involve a lot of kinds of IoT technologies yet. This could be a good plan for us to involve IoT in the future.	The proposed architecture is already quite comprehensive. However, the use of IoT in the Indonesian context still requires further study due to limitations in Internet connectivity and even electricity in some underdeveloped areas.
4.	How well does the proposed architecture provide standardized guidelines to facilitate the collaboration of	Standard guidelines are needed in implementing a program. Therefore, the business process shown shows what access there is in building standard	So that the guidelines are conveyed well after the smart tourism system is running, this can be done with interactive advertising.	In general, for some audiences with less context, this viewpoint can be quite ambiguous to the viewpoint shown earlier. The reason for this is that I see this viewpoint as a visualization of the	Measured as good. But there are business processes without trigger relation. Business functions instead?	This standard helps us to perceive the same understanding of the smart city project as government personnel.	The designed architecture is quite comprehensive and detailed.

	the smart tourism ecosystem?	guidelines for implementing smart tourism in the city of Pontianak.		responsibilities that each stakeholders need to carry out to realize the smart tourism ecosystem			
5.	How well does the proposed architecture enable and support the stakeholders to operate smart tourism effectively?	The Pontianak City Government has built access for collaboration between various parties in smart tourism through the RUMPON and RUMAKTIF communities. Collaboration from various parties creates activities to support smart tourism (Smart branding) and increase the local wisdom of Pontianak City.	This is like unifying the business model between the government and tourism organizers. If the collaboration runs by this architecture, a good tourist experience can be realized thanks to the help of the technology will be built.	The proposed architecture may be able to enable the stakeholders to operate smart tourism effectively. However, there might be cases, or countries, or regions, where involving 3rd party providers can be more sustainable to run the operation and the development. As governmental agencies need to stay non-profit, sustainability aspect in such an initiative might be seen as a conflict of interest to some other stakeholders.	Measured as good. However, are there roles from third party service providers? Like Traveloka or something?	The existing organization within the government can be utilized to fill the role that is proposed. Thus, this could be a starting point to direct departments to support smart tourism.	The designed stakeholder viewpoint is quite comprehensive and detailed and is able to describe the current conditions in Indonesia.
6.	To what extent does the LeanIX software reflect the ArchiMate reference architecture and help to manage the Smart Tourism strategy?	This reference architecture is a really good solution to realize smart tourism practices that support tourism competitiveness for our city. Currently, we need more coordination between the department and stakeholders. This mapping helps us to understand the current situation and strategy.	I believe this architecture can realize coordination between the government to integrate applications supporting each tourism site's promotion.	Which aspects of developing countries are already reflected in the viewpoints?	Measured as good. It needs to be instantiated by demonstrating a set of platforms in the smart tourism ecosystem to understand better its supporting capability.	Overall it is an excellent solution that is provided to enhance our Pontianak Smart City Master Plan.	In my opinion, the use of LeanIX is very relevant and needed by governments in developing countries, especially in the context of ensuring that the procurement of platforms does not deviate significantly from the designed enterprise architecture.
7.	To what extent does this reference architecture support the tourism competitiveness of developing countries?						

Appendix C

Consent Form

Consent Form for Master's Thesis
Smart Tourism Platform Reference Architecture for Developing Country
Dimas Apriyandi – Master of Business of Information Technology at the University of Twente

Taking part in the study

I have read and understood the study information dated [30/10/2023], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves an audio-recorded interview, and it will be transcribed as text.

I understand that taking part in the study involves a collaboration to co-create architecture for Pontianak's City smart city project in tourism domain.

Use of the information in the study

I understand that information I provide will be used for reports, and a smart tourism platform reference architecture for developing country.

I understand that personal information collected about me that can identify me, such as my name or where I live, will not be shared beyond the study team.

I agree that my information and real name can be quoted in research outputs

Future use and reuse of the information by others

I give the researchers permission to keep my contact information and to contact me for future research projects.

Signatures

[redacted]		30-10-2023
Participant Name	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Dimas Apriyandi		30-10-2023
Researcher Name	Signature	Date

Study contact details for further information: Dimas Apriyandi – Master of Business of Information Technology (dimasapriyandi@student.utwente.nl)