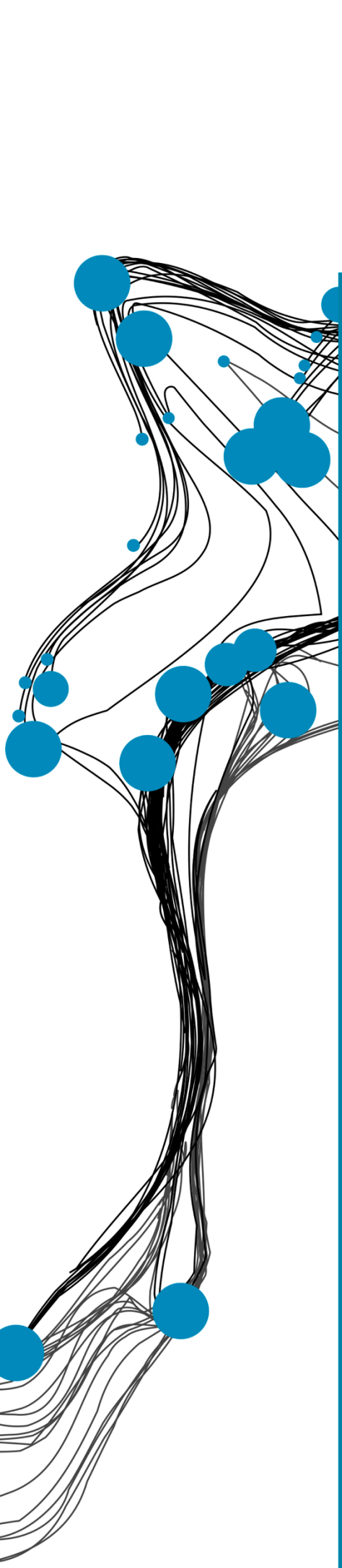

Master Thesis

A Service-Oriented Business Collaboration Reference Architecture for Rural Business Ecosystem

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Danniar Reza Firdausy

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Abstract

Earlier research has shown that by establishing business collaboration with mutual partners through the provision of a collaborative service platform that enables information interoperability and service orchestration, shared benefits of a lowered entry barrier and improved competitiveness could be achieved. However, these projected shared benefits have not been able to be perceived by rural business entities, who have been in the ongoing effort to establish the means to stimulate innovation and competitiveness to improve their economic welfare. One of the promising approaches is by empowering their existing assets and making the rural businesses smarter through the provision of a collaborative service platform that is aimed to grant them improved access to a more established network of marketplaces. This effort leads to the participation of diverse application components and business processes that motivates the need for a reference architecture to streamline the provision of this collaborative service platform for the rural business ecosystem. Given this objective, this research designed the reference architecture of service-oriented business collaboration platform by first exploring the architectural components that are essential to alleviate rural businesses' entry barrier to the digital business ecosystem. A number of architectural viewpoints that focus on overseeing the provision of Sales Order, Funding Source, and Tourism Promotion Management was delivered from this process. In order to discover the effects generated from the implementation of this reference architecture, an instantiation into a concrete architecture applied to West Java Digital Province initiative was performed. A working prototype based on the architecture was also developed and demonstrated to a group of representatives from the initiative. From the interview session, with the obtained average score ranging from 4.2 to 4.5 and standard deviation smaller than 1, it is concluded that all respondents have generally approved that this architecture has presented the essential components to lower the rural business ecosystem entry barrier to the digital business ecosystem.

Keywords

Reference Architecture, Service-Oriented Architecture, Business Collaboration Platform, Rural Business Ecosystem, Web Service, ArchiMate

1. Introduction

In the modern business ecosystem of late, a collaboration among mutual business partners is regarded as a prominent key enabler in stimulating innovation and gaining competitive advantage. While the competition itself can also act as a driver of change, a past study has stated that business operations in a collaborative manner with a value net of partners is essential in order for an enterprise to evolve (Sayah & Zhang, 2005). These value net, or value chain, partners may consist of multiple companies actively established in multiple industrial domains such as companies in a network of logistic providers, financial services, manufacturing suppliers, or even sales and marketing entities. Previous studies have noted that efficient cost reduction, possibilities to a business partnership to fulfill bigger business opportunities, and the potential to unlock new business models are few key points of the many anticipated benefits through a collaborative and coordinative business ecosystem in which is enabled by the implementation of modern information technology (Xu et al., 2010; Zhu et al., 2010).

Considering the diverse information technology being used by the collaborating partners, efforts have been directed mainly to leverage the coordination of information flow among them to achieve a mutually beneficial business relationship. In the effort towards orchestrating these divergent business processes in an inter-enterprise business collaboration setting, Service-Oriented Architecture (SOA) has been regarded as the favored software system design decision (Deng et al., 2008). SOA takes the design paradigm of encapsulating the application services from diverse heterogeneous information systems that derived from certain business rules, exposes these services while adhering to certain Web Standards and then coordinate between services from multiple parties to execute the collaborative business processes with high flexibility and efficiency (Xu et al., 2010). For the past two decades, multiple industrial business domains have been identified to adopt the concept of SOA in order to collaborate and be interoperable with value partners. Most of the time, this collaboration initiative is being realized into a collaboration platform that facilitates information interoperability among partners as well as to establish services orchestration published by diverse information system maintained by multiple stakeholders forming a set of collaborative business process (Lorré et al., 2006; Xu et al., 2010).

However, smaller business entities, such as the ones operating in the rural business ecosystem, have not been able to establish and perceive the advantage of this collaboration platform approach. The focal reason behind this phenomenon is the limited access to the business supporting and collaboration enabler technology available to them despite the positive eagerness indicated in the social environment (Parikh et al., 2015; Schaffers et al., 2016). These access limitations can be in the form of knowledge and capabilities limitations as well as resources or financial limitations that take the form of a high entry barrier. Furthermore, due to their isolated operations and limited promotion capacity, in addition to the reduced degree of information technologies to leverage business collaborations with partners, these rural business entities are suffering from a low level of competitiveness (Cunha et al., 2020). This limitation imposes them to have a high concentration of low added value creation activities that correspond to the limitation towards their low economic growth and perceived social welfare, which ultimately leads to the high rate of rural to urban migration that has been assumed to be the cause of increased poverty in urban areas (Imai et al., 2017).

In response to these limitations and incompetence, the notion of Smart Rural has been introduced to the context of rural areas lately. In the rural context, the adoption of Smart Rural or Smart Village refers to rural areas or communities that manage and improve their micro-economic potential and living standards as well as developing new business opportunities by building on their existing strengths and assets through the implementation of innovative ICT infrastructures and development of digital literacy (Mishbah et al., 2018; Zavratnik et al., 2018). It is believed that one way to implement innovative ICT infrastructure in a rural context is the provision of an information services platform that acts as a bridge between the government policies and the potential of rural areas, as well as to promote the potentials of collaborations among business entities (Cunha et al., 2020; Mukti, 2019). Moreover, the provision and utilization of IT in the form of a service platform that enables collaboration, promotion, access to funding sources, and public services in rural areas has also been deemed necessary in order to stimulate economic growth (Juditha & Islami, 2018; Sari et al., 2018).

This initiative of Smart Rural implies that there is an apparent link to connect the desire of rural development through the collaboration in their rural ecosystem with the adoption of business collaboration platforms based on the SOA approach. Multiple prior kinds of researches have been conducted in this field of study in order to obtain a set of different aspects of rural development such as to identify the strategy to develop ICT for rural areas (Sari et al., 2018), or to explore the principle components underlying a smart village conceptual model (Mishbah et al., 2018). However, rarely have been identified to propose a reference architecture that constitutes the basis towards the collaborative rural business ecosystem. Meanwhile, the provision of a reference architecture, in this case, can bring benefits to a real-world system design process as to facilitate a clear judgment and decision making for the stakeholders in a specific application context (Angelov et al., 2012). Based on this, in this research, a reference architecture of Service-Oriented Business Collaboration (SOBC) for a rural business ecosystem is proposed.

1.1. Research Objectives

A recent discovery has shown that an increasing level of rural-to-urban migration is in fact contributed to the increase of poverty level in multiple cases of big cities, instead of solving the problems related to poverty or the economic gap between rural and urban (Imai et al., 2017; X. Q. Zhang, 2016). One of the promising approaches to tackle this problem is to develop the rural economy and potentials by making the rural areas smarter through the provision of collaborative service platforms (Cunha et al., 2020; Mukti, 2019; Zavratnik et al., 2018). However, due to the potential participation of diverse application components from different stakeholders that serve heterogeneous application processes, business processes, and business functions, as well as goals to achieve, a unified enterprise architecture is required in this case in order to streamline the provision of this collaborative service platform with the collaborative business aspects and high-level goals that the involved stakeholders want to achieve. Therefore, this research is carried out to serve the objective of:

- ***Propose a reference architecture of service-oriented business collaboration for the context of business ecosystem in rural areas***

In order to validate the perceived benefits this reference architecture may bring with respect to the stakeholders operating in the rural context, multiple sequential phases will be required. The first is to conduct a systematic literature study in order to discover a preliminary Service-Oriented Business Collaboration reference architecture that is constituted from architectural components that are identified from relevant research journal publications. The second is to identify the context that this reference architecture can be further developed, implemented, and validated. Next is to formulate a concrete enterprise architecture based on the developed reference architecture that is tailored specifically for the determined context, which is the rural business ecosystems. This concrete architecture will then encompasses the functional requirements for a working prototype that adheres to the developed reference architecture, which this prototype will be tested on the stakeholders of a simulated context in order to obtain feedback and validate the design decision of the reference architecture.

1.2. Research Questions

In order to achieve the earlier stated goal, the main research question needs to be specified beforehand. This main research question help to set the required steps to achieve the defined research objectives earlier by underlining a set of sub-questions. The main research question of this research project is formalized as:

- ***How can a service-oriented business collaboration platform be introduced to a rural business ecosystem?***

This question is then divided into the following sub-questions:

1. ***What is the state-of-the-art in Service-Oriented Business Collaboration platform reference architecture?***
   First and foremost, the current state-of-the-art reference architecture of Service-Oriented Business Collaboration will be extracted from scientific journal articles in the past two decades. In Chapter 2, a systematic literature review that shows the essential constructs for SOBC is presented. Section 2.6 then summarizes the findings of the literature review and the resulting state-of-the-art reference architecture of SOBC.

2. ***How can the reference architecture of a Service-Oriented Business Collaboration platform for a rural business ecosystem be specified?***
   Chapter 3 elaborates on the design of the reference architecture of SOBC for rural business ecosystems based on the current state-of-the-art reference architecture of SOBC identified in Chapter 2. In this chapter, further development of the SOBC reference architecture, which takes into account the relationships between the goals, architecture design, and intended context in a rural business ecosystem, is presented.

3. ***How the concrete architecture of a Service-Oriented Business Collaboration platform be instantiated to support rural businesses in West Java Province, Indonesia?***
   Chapter 4 describes the process to design the concrete architecture of the SOBC platform for rural business ecosystems based on the reference architecture obtained in Chapter 3. This process will require a practical condition of a real-world problem

that serves as a case study to implement this reference architecture into a concrete architecture. Furthermore, this concrete architecture is then be instantiated into a working prototype for the defined case study to be validated. This case study will take place as the collaboration initiative for a rural business ecosystem in West Java Province, Indonesia.

4. ***What effects are produced by the implementation of the concrete architecture of a Service-Oriented Business Collaboration platform for a rural business ecosystem?***
   Chapter 5 attempts to discover the effects that emerged from implementing the concrete architecture of an SOBC platform for a rural business ecosystem by validating it with regards to the extent that the proposed concrete architecture and its working prototype satisfies the defined goals or meets the identified requirements. Therefore, a workshop session with stakeholders of the West Java Digital Province Initiative will be established to present and demonstrate the proposed architecture and its application prototype. Finally, a qualitative analysis will be used for this validation research by designing a set of interview questions that correspond to the satisfaction level of each of the defined requirements.

1.3. Research Scope

The scope of this research is in the design, delivery, and validation of a reference architecture that can be used to facilitate the design of a collaborative platform for a rural business ecosystem by providing sponsor organizations and their participating partners with a reusable and adaptable architecture to the context. The study of business collaboration in the rural business ecosystem itself may involve participation from a diverse set of organizations or business instances that reside in varying kinds of industrial domains. Due to this fact along with the high probability that the business processes established by each of the service providers to be very large and complex in real-world conditions, this study only considers a simplified version of the relevant important activities to be implemented in the working prototype.

1.4. Definitions and Research Methodologies

In order to obtain a better understanding of the topic in this research, a single definition derived from multiple studies should be laid out beforehand. This definition derivation will be further detailed in the following subsection. Furthermore, since a design and a delivery of a reference architecture is part of the aim of this research, the knowledge domain along with the utilization of a framework that serves as a guideline to perform this task will be discussed. Additionally, the research methodology that guides the motion and structure of this research will also be discussed in the later subsection.

1.4.1. Service-Oriented Business Collaboration

The understanding of Business Collaboration takes the form of many different definitions across several scientific publications. According to (Haiyang et al., 2012), Business Collaboration is about coordinating the flow of information among multiple organizations in

a distributed environment with a dynamic availability of heterogeneous sources and linking their business processes into a cohesive whole. Complementing this explanation, Sayah and Zhang (2005) have stated that a collaborative approach in a value net of business entities aims to develop a beneficial value chain that enables the creation of a more innovative and competitive business ecosystem. Another study has defined this value net of collaborating businesses as Networked Enterprises (NEs), which comprises distributed enterprises with different cultures, working methods, and competencies combining the most suitable set of skills and resources in a specified period of time to reach common objectives (Shirazi, 2018). Taking the context of enterprises operating in a network, Aulkemeier et al. (2019) have stated that for them to be able to collaborate successfully, a strong information technology support is required. This statement also has been supported by Sayah and Zhang (2005) that a consistent outcome from a collaborative approach could only be realized through the support of a service system that is capable of facilitating the formation of alliances among service providers offering services to be used by the other external service.

An application architecture, in which all functions are defined as independent services with well-defined invokable interfaces that can be called in defined sequences to form business processes is what Schulte et al. (2008) have defined as the concept of SOA. Shirazi (2018) has also noted that the main feature to be expected from the implementation of SOA is the orchestration of services through a certain mechanism, providing a new integration and flexible solution to support the business agility requirements. In relation to the concept of collaboration, Schulte et al. (2008) have also proposed the definition of service-oriented collaboration as an intra- and inter-corporate collaboration based on service-oriented technologies, however, this definition has not yet described the concept as a whole. Although not explicit, it can be deduced that Orriens et al. (2005) has defined Service-Oriented Business Collaboration as a form of cooperation among multiple enterprises working together in achieving a set of business goals and realizing adaptable business services by utilizing existing services through cross-organizational boundaries.

Based on the presented related definitions, this paper defines Service-Oriented Business Collaboration as “the joint effort among multiple business entities in coordinating the flow of information by combining the suitable set of resources along with leveraging a well-defined invokable independent services application (system) architecture capable of forming a business process orchestration in order to achieve common goals”.

1.4.2. Enterprise Architecture and ArchiMate Modelling Language

To date, multiple definitions of Enterprise Architecture (EA) have been outlined by numerous researchers as well as practitioners in the field. Lankhorst (2016) has described the term Enterprise Architecture as a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise’s organizational structure, business process, information systems, and infrastructure. Complementing this definition, Johnson et al. (2004) defined Enterprise Architecture as a model-based management and planning approach for the evolution of organization-wide information systems that respond to the ever-increasing significance and complexity of business-supporting information systems. Based on these two definitions, Enterprise Architecture can be used and viewed as a blueprint for the whole intra- and inter-organizations that are interacting with each other and provides a comprehensive and integrated view of the principles, methods, and interaction representations within an enterprise. As a model-based approach, a typical EA model

provides a distinction between the constructs of business processes, data and application representations as well as technological infrastructure. Moreover, an EA model also facilitates the provision of a viewpoint that elaborates multiple levels in an organization and supports their business and IT alignment.

An EA standard framework that is well known so far and the most used in practice is The Open Group Architecture Framework or known as TOGAF (The Open Group, 2011). According to this framework, utilizing the approach of EA is to serve the purpose of optimizing the structure across an enterprise that is often fragmented into an integrated environment that is responsive to change and supportive to the delivery of the business strategy. However, as opposed to the earlier model-based nature of EA, TOGAF, as it is, does not provide the means to facilitate an enterprise architecture modelling purpose.

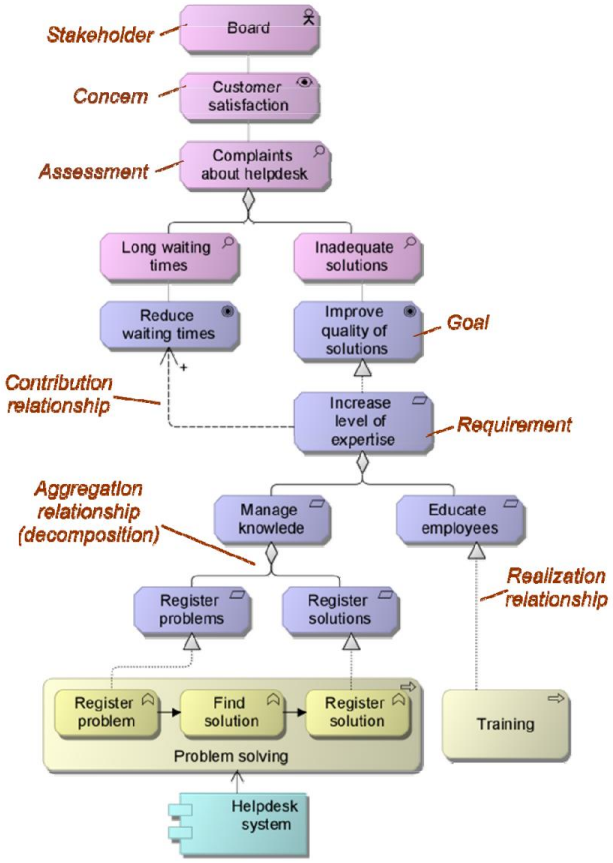

Figure 1 Example of an ArchiMate Viewpoint (Jonkers et al., 2011)

In order to account for this shortcoming, The Open Group has published the ArchiMate language for the purpose of enterprise architecture modelling (Lankhorst, 2016). The core of ArchiMate language distinguish three main layers:

1. The business layer offers products and services to external customers, which are realised in the organisation by business processes, business functions, business services etc.
2. The application layer supports the business layer with application services which are realised by application components.
3. The technology layer offers infrastructural services needed to run applications, realised by computer and communication devices and system software.

However, the full ArchiMate language further extends this core language with a number of additional layers and concepts in order to provide an extended support for the architecture development process, such as:

4. Motivation concepts, to model the reasons behind the choices made in the architecture.
5. Strategy concepts, to model the strategic level of the enterprise with its capabilities, resources and the courses of action it may take.
6. Physical concepts, to model the physical world of equipment, materials and transport.
7. Implementation and migration concepts, to support project portfolio management, gap analysis and transition migration planning.

1.4.3. Reference Architecture Design Framework

The definition of reference architecture takes place in many different forms across studies and disciplines. Fettke and Loos (2007) uses the term reference model to refer to a conceptual framework or a blueprint that is valid for a class of domains, derived from and provides best practices for conducting business and could be reused in multiple information system development projects. Angelov et al. (2012) took this definition even further by stating that a reference architecture defines a generic architecture that contains minimum architectural elements that cover required functionalities for a class of systems that is used as a basis for the design of a concrete architecture of the same class. The use of reference architecture is believed to bring benefits such as decreasing modelling cost, time, and risk in multiple projects of a similar domain class and especially beneficial to organizations with limited resources due to the reusability property of it.

Since reference architectures present generic constructs and configurations of a domain class, it means that a reference architecture should be reusable and able to provide a reliable base for future architecture development. This generic nature of a reference architecture can be achieved by designing them at a higher level of abstraction that is induced by their specific contextual usage, allowing its usage in differing contexts under the same domain class. On the contrary, an architecture that is designed and used for the development of a specific software application in a specific context can then be categorized as a concrete architecture.

Angelov et al. (2012) presented a multi-dimensional classification with the aim to support the analysis and design of a reference architecture that is based on the relationships between its context, goals, and architecture design. The context dimension concerns the “Where” will this reference architecture be used, “Who” defined it, and “When” is it defined. This “When” sub-dimensional context determines a reference architecture as a classical if it is defined when technology, software, and algorithms required for the application exist and have been tested in practice. Otherwise, it is defined as a preliminary reference architecture if the technology or algorithm has not yet existed in practice by the time of its design. The goal dimension aims to provide the reason why the reference architecture is defined. Whereas the design dimension specifies the reference architecture in terms of the level of detail, type of elements or information that can be defined, level of abstraction as well as level of formalization. These multidimensional based classification results in five possible types of reference architecture:

1. A classical, standardization reference architecture for multiple organization

2. A classical, standardization reference architecture for single organization
3. A classical, facilitation architecture for multiple organization by an independent organization
4. A classical, facilitation architectures designed for single organization
5. A preliminary, facilitation architecture for multiple organizations

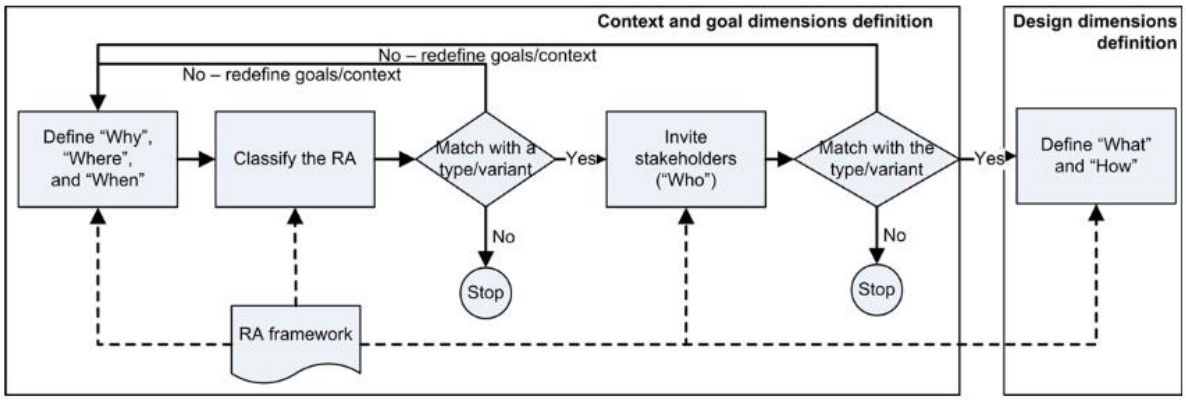

Figure 2 Framework usage in designing a reference architecture (Angelov et al., 2012)

Additionally, Angelov et al. (2012) have extended this classification into a framework that can be used to design a new reference architecture. Figure 2 above shows the approach to use the framework, which is initialized by specifying the architecture goal, determining the architecture context in terms of the organization type being applied as well as designating the timing aspect of the design. Next is to assess whether these initial inputs match with one of the five possible types of a reference architecture. When the match is found, the project sponsor should approach the stakeholders that have to be involved according to the type description and then further define the architectural elements to be contained along with the level of abstraction and formalization. However, so far, this Architecture Design and Specification dimension in this framework only facilitates the guideline to determine the level of abstraction in formalizing the reference architecture, without a procedural guideline on how to design and specify the architectural components to fully answer the "What" question identified in this particular dimension.

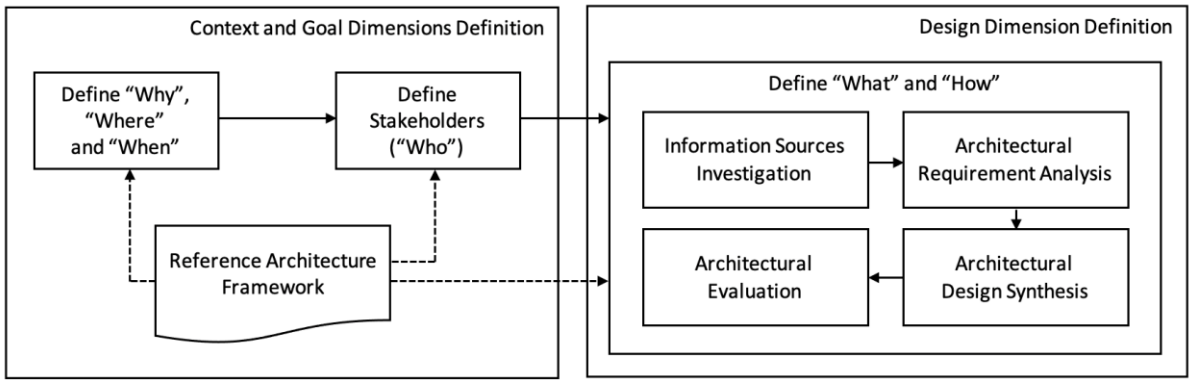

Figure 3 Integrated Reference Architecture Design Framework

To fill in the blanks left by the discrepancy mentioned earlier, a framework proposed by Nakagawa et al. (2014) called ProSA-RA is being referred in this case. The same framework has been referred by Rohling et al. (2019) as well in their research to develop a reference

architecture for satellite control systems. This framework facilitates systematic design, representation, and evaluation of a reference architecture. According to this framework, the process to formulate a reference architecture is initiated by the selection and investigation of information sources. The second step is to identify the architectural requirement of the reference architecture, which is then followed by the definition of the architectural description. Lastly, an evaluation of this formulated reference architecture is conducted. Rather than to oppose the framework from Angelov et al. (2012) earlier, this framework is being referred to complement the definition of the Architecture Design and Specification dimension as well as to be used as a procedural guideline in designing and specifying the architectural components that constitute the reference architecture. Figure 3 above represents the resulting incorporation of the two discussed frameworks.

1.4.4. Design Science Research Methodology

Peffers et al. (2007) quoted the term design science as an attempt to create and evaluate artifacts (may include constructs, models, or instantiations) intended to serve human's purpose or solve identified organizational problems, which will result in building system instantiations to a problem formulated for the defined purpose as the research outcome. R. J. Wieringa (2014) have suggested a more simplified and generalized definition of design science as the study of artifacts designed to interact with a problem context in order to improve the condition in that context. Since a typical design science project iterates over the activities of designing and investigating, the design task is decomposed into three tasks consisting of problem investigation, treatment design, and treatment validation, which are represented in Figure 4 below.

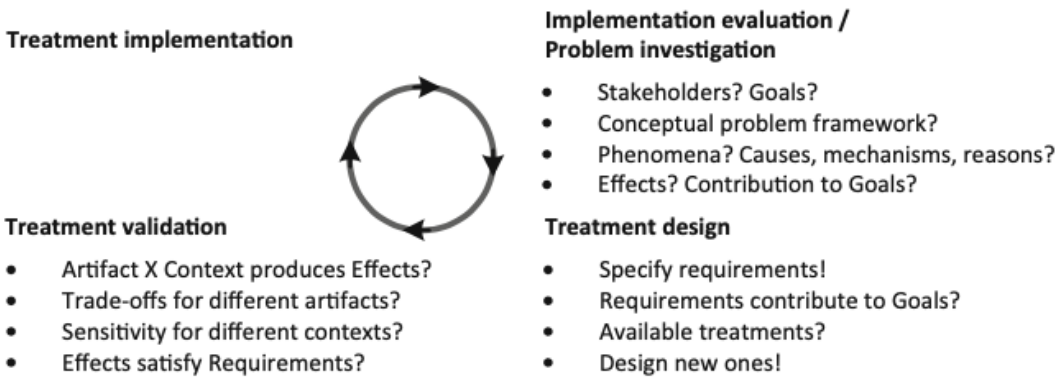

Figure 4 Design science engineering cycle (R. J. Wieringa, 2014)

In design science, one of the research methods that can be used to evaluate or validate an architecture implementation is the Single-Case Mechanism Experiment. This research method aims to gain insight into the behavior of the artifact and the phenomena in the real world. It is a test of a mechanism or validation model applied to a single object of study with a known architecture. This validation model, which consists of an artifact prototype interacting with a simulation of the intended context, is designed to assess the validity of the interaction between the artifact model and its context model in respect to their target implemented artifact and its intended context.

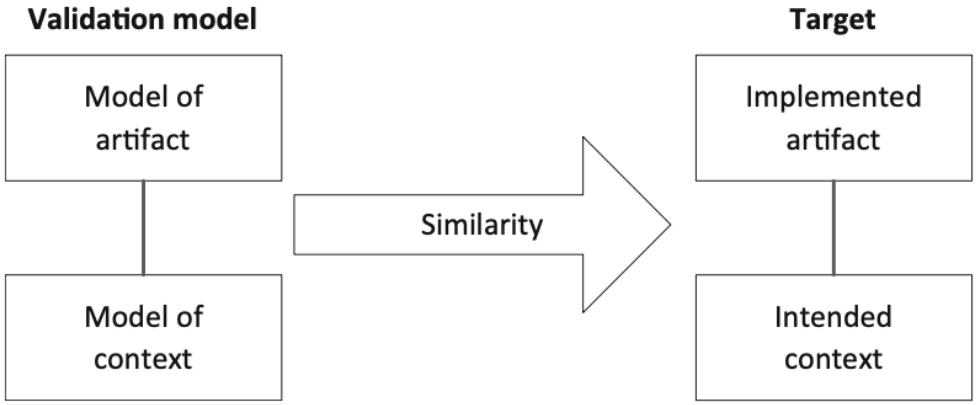

Figure 5 Validation Model represents its targets by similarity (R. J. Wieringa, 2014)

In order to assess the validity of the validation model, the artifact model and context model should be treated to a certain scenario of the case study. This means that in the validation research, the researcher must decide a certain application scenario to test on which context model of the case study. In terms of measuring the performance of the validation model, the definition of measured variables and their scales are required. However, these measurement variables might have also been designed in advance as part of the artifact design. In this case, an extension of the proposed artifact with additional constructs and indicators may be required to operationalize the measurement.

1.5. Research Structure

This study is conducted following the guideline of Design Science Research Methodology (DSRM) that uses Expert Opinion and Single-Case Mechanism Experiment as the validation method as proposed by R. Wieringa and Moralı (2012). The following Chapter 2 answers the first research question through a systematic literature study (SLR) conducted to obtain the general state-of-the-art SOBC platform reference architecture. Then, this general reference architecture will be further specified for the context of a rural business ecosystem in Chapter 3, following the multi-dimensional reference architecture design framework proposed by Angelov et al. (2012). Further, we specify this resulting reference architecture into a concrete architecture as well as instantiate it into a working prototype in Chapter 4. Next, in Chapter 5, we evaluate the perceived effects of the SOBC platform for rural business ecosystems after it is validated in a client case study according to the TAR approach in DSRM. Lastly, Chapter 6 then will discuss the conclusion, limitation, and recommendation for future work.

2. State of the Art SOBC Platform Reference Architecture

As mentioned in the previous chapter, the current state-of-the-art reference architecture of SOBC will be extracted from scientific journal articles. In order to explore the latest development and to obtain the relevant constructs that constitute the desired general reference architecture for SOBC, in this chapter, a systematic literature review (SLR) is performed. In the following sections, the methodologies used as a guideline for this SLR will be described, along with the result analysis and the identified reference architecture of SOBC platform that concludes this chapter.

2.1. Methodology

The SLR method being used in this research is following the methodology used by Rouhani et al. (2015), which is also based on the guideline to conduct SLR in software engineering proposed by Kitchenham and Charters (2007). This SLR process outlines three major consecutive phases, which are initialized by Planning, Conducting, and Result Analysis. In this paper, the Conducting will be called as Selection, since the underlying activities are mostly revolving around the selection of previous studies. A more detailed activity is listed in Table 1 below and will be further described in the following sections.

Table 1 SLR Activities

Planning	
1	Define main the Research Question and its Sub-Questions
2	Select scientific databases
3	Formulate search query based on the main Research Question
4	Define inclusion and exclusion criteria
Selection	
5	Execution of the formulated search query for each scientific database
6	Article selection to each query results by inclusion criteria
7	Remove duplicate studies across scientific databases
8	Exclusion of irrelevant articles based on title and abstract assessment
9	Exclusion based on full text availability and its assessment
Result Analysis	
10	Data extraction according to defined main RQ
11	Synthesis of the extracted data
12	Report synthesis result on defined main RQ

2.2. Planning

This section will focus on defining the objectives of this review and the way this review will be carried out. The first is to define the research questions, then select scientific databases to perform the formulated search queries along with defining the criteria used to include and exclude search results.

2.2.1. Research Questions

Kitchenham and Charters (2007) pointed out that research questions determine how the search process, data extraction, and data analysis will be performed in order to answer them. This chapter aims to explore the latest development in SOBC by identifying the relevant constructs that constitute the desired general reference architecture for SOBC as well as how these constructs can be constructed into a reference architecture. In order to facilitate this intent, the motivations in the adoption of SOBC platform, the industrial domain and organizational structure this concept is being applied, architectural components and patterns that are being presented, as well as the utilized technology that acts as the enabler of SOBC platform should be investigated. Therefore, the research questions for this SLR are formulated as follows:

Main RQ:
What is the state of the art in Service-Oriented Business Collaboration platform?

SLR RQs:

1. What are the motivations for the adoption of Service-Oriented Business Collaboration platform?
2. Where is the Service-Oriented Business Collaboration platform applied?
3. How is the architecture of Service-Oriented Business Collaboration specified and what kind of components or pattern can be found in the literature?
4. What type of technology is used in such Service-Oriented Business Collaboration platform?

2.2.2. Scientific Databases

This section defines the scientific databases chosen for this review in order to obtain relevant academic publications and answer the defined SLR research questions. The scientific databases selected for this review consisted of:

- Scopus (https://www.scopus.com)
- IEEE (https://ieeexplore.ieee.org)
- Web of Science / WoS (https://webofknowledge.com)

These databases are chosen since they are able to provide good coverage of both the latest and earlier academic literature relevant in this knowledge domain. Moreover, these databases are regarded as the top 5 most trusted academic resource databases. Although, the 3rd academic database is specialized in medicine or biological sciences, and the 4th database hosts publications specifically for education sciences. Hence, the 5th database, WoS, is selected.

2.2.3. Search Query Formulation

The search query is formulated based on a set of keywords related to the research questions. The main keywords are obtained from the relevance towards answering the main question as well as the sub-questions. For example, the incorporation of Technology is expected to contribute in answering the last sub-question that is related with the involved

technology in the study. Furthermore, synonyms are also defined for each main keyword as to widen the articles that can be gathered. The following Table 2 lists the obtained keywords and these keywords will be used to formulate the search query for each scientific database.

Table 2 Search Query Keywords

Service oriented	**Organization Structure**	**Collaboration**	**Technology**	**Industry Area**	**Architecture**
Service-oriented	Business	Collaboration	Platform	Logistic	Architecture
SOA	Enterprise	Cooperation	Web Application	Government	Pattern
Microservice	Supply Chain	Connectivity	Web-service	Tourism	Reference
	Ecosystem	Coordination		Finance	
	Networked Business	Integration		SME	
	Business Network	Interoperable		Region	
		Inter-organizational		City	
		Inter-organizational		Village	

Based on the keywords listed earlier, search queries for each scientific database are formulated by clustering the synonymous keywords together using the logical operator “OR” and further attached by the other clusters using the “AND” operator. In order to further control the relevance of the search result, the search query is applied to the article’s title, abstract, and keywords. The resulting search query for one of the scientific databases (in this case, Scopus) is as follows:

Scopus (advance search):

TITLE-ABS-KEY (
("Service-oriented" OR "SOA" OR "microservice")
AND
(business OR enterprise OR "supply chain” OR ecosystem OR “networked business” OR “business network”)
AND
(collaboration OR cooperation OR connectivity OR coordination OR
integration OR interoperable OR “inter-organisational” OR “inter-organizational” OR “inter-enterprise”)
AND
(platform OR "web application" OR “web service” OR “web-service”)
AND
(logistic OR government OR tourism OR finance OR sme OR region OR city OR village)

AND
(architecture OR pattern OR reference))

2.2.4. Inclusion and Exclusion Criteria

Kitchenham and Charters (2007) stated that defining the selection criteria is essential in order to reduce the likelihood of bias in the search process and can help to identify the direct evidence towards the primary study. In this section, the inclusion and exclusion criteria are defined and listed in Table 3. Following this, articles which are complying the defined inclusion will be chosen as candidates and likewise, the ones which do not satisfy the exclusion criteria will be removed.

Table 3 Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
English based peer-reviewed Studies	Studies that are not related to the main RQ from title, abstract, and content
Studies published in Conferences Proceeding and Journal Articles	Duplicate articles by title or content
Study areas focusing in the field of Computer Science, Engineering, Business Management & Accounting, Social Science	Articles that are not complete or too short

In this part of the research, the articles being included are the ones that are written in English in order to ensure that the selected articles were internationally peer-reviewed. As peer-review has been taken into account, studies published in Conferences Proceeding and Journal Articles are selected with the same consideration as well as to ensure the quality of the publication. Further, included study areas as mentioned are being used to maintain the relevance of the search result towards the primary study. As for the publication year, this study does not limit the search criteria in order to capture the overall development of the topic. Meanwhile, this review excludes studies that from its title, abstract and content do not present relations towards the main research question or towards the topics of service-oriented architecture nor business collaboration. Moreover, since the same article is common to be found in multiple scientific databases, duplicates indicated by their similar title or content will be reduced. Lastly, incomplete articles or the ones that are too short, such as only presenting their first page obtained from an online search, will also be removed.

2.3. Selection

In order to further increase the relevancy of this review towards the primary study and prevent overspending the time reading irrelevant publications, the gathered articles need to be reviewed first. This process is being done in multiple steps, first is to execute the defined search queries on each scientific database and then continued with the second step, which is applying the inclusion and exclusion criteria as described earlier. Next, the obtained search results' metadata are exported to EndNote in order to be further selected based on the title and abstract. The third step is to remove duplicate results based on their title and abstract.

Fourth, is to gather the selected articles' full text and remove the ones that cannot be found in its full-text document or the ones that its full text is incomplete. The fifth step is to assess the articles' full text and only articles that provide discussions that are close towards answering the main and sub-questions are selected. By the end of this process, 29 articles are being selected from 89 full-text available articles and the flow of the complete process is visualized in the following Figure 6.

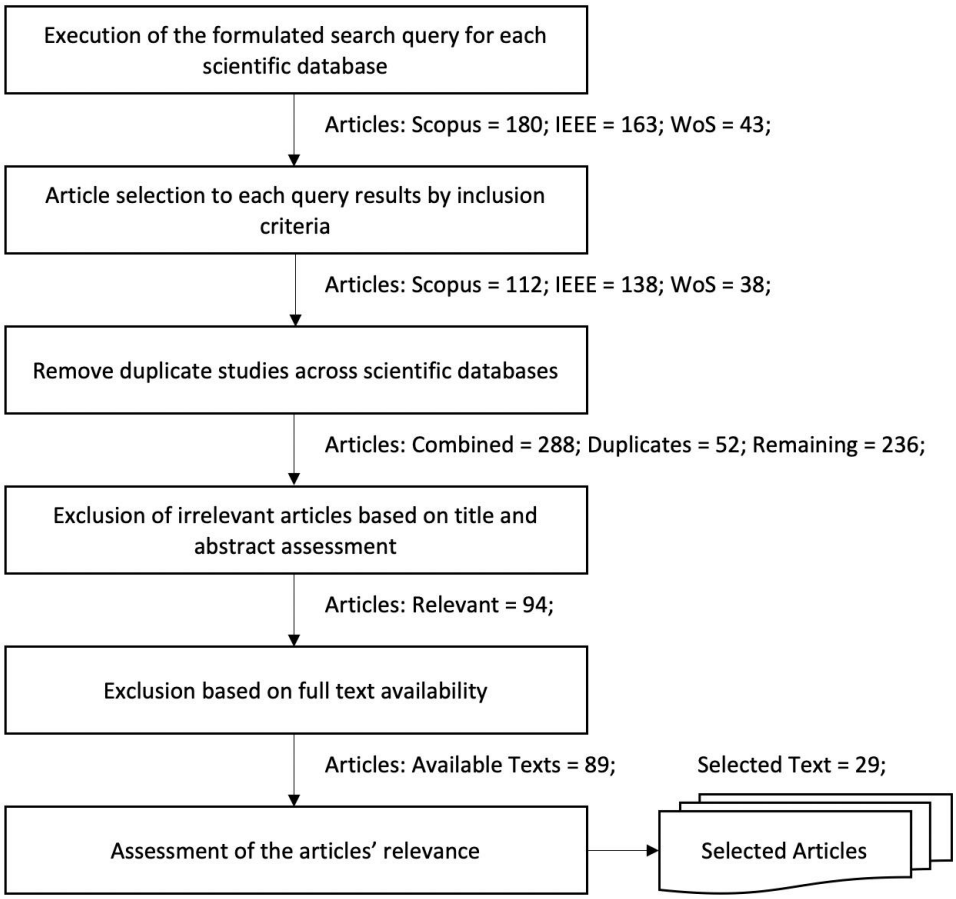

Figure 6 SLR Articles Selection Flowchart

2.4. Data Extraction

Following the selection of the articles, relevant information that are essential towards addressing the defined research question should be collected. These extracted contents will further contribute towards formulating the reference architecture through a synthesis process that will be thoroughly discussed in the next section. The following Table 4 presents the form that is being used to assess the contribution of the selected papers in relevance towards the construction of SOBC platform reference architecture. Particularly, the Research methods in this form, which consist of literature review (LR), observation (O), and experiment (E), were being used by Rouhani et al. (2015) in order to identify the used technique for the design of the selected studies. In addition, they are being identified in this review in order to discover how the output from studies on this topic is being formulated. Furthermore, as Rouhani et al. (2015) have mentioned in their literature review, data extraction from the selected studies is key in order to answer the previously defined research questions. This information-gathering process is being explained in the latter part of the following Table 4.

Table 4 Quality Assessment and Data Extraction Form

No.	Extracted Data		Description
1	Bibliographic Reference		Presents the authors and year of publication of the research article
2	Research Purpose		Describe the proposed solution and discussion in relevance towards SOA/BC.
3	Research Method	Literature Review	Have formulated the proposed solution by conduction a literature review
		Observation	Evaluate an implementation in a case study without enforcing any influence
		Experiment	Implement an artifact and evaluate the effects it may bring into the case study
4	Research Output	Theoretical	Brought forward the general idea, dis- and advantages or design principles of either SOA or Business Collaboration
		Conceptual Model	Complemented the theory by illustrating the graphical illustrations of the theoretical design decisions of the model that the studies are adhering to
		Architecture	Proposed the architecture of their case study, by including the design decisions of the model that these studies proposed
		Implemented Artifact	Describe how is the solution for their case study has been implemented
5	Research Contribution	Motivations	The underlying conditions or goals that the participating organizations in an SOBC initiative want to achieve
		Applied Domains	Which business domain or what kind of organizational structure is the concept of SOBC or its platform being applied
		Architectural Components/Patterns	How is the architecture along with its constructs or pattern of SOBC platform can be identified
		Technology	Expose the technologies being used in order to realize the SOBC platform

2.5. Result Analysis

This section presents the results from the previous data extraction in respect to answering the defined SLR research questions. This section is structured to first list the motivations in the adoption of the Service-Oriented Business Collaboration platform or initiatives. The second is to list the industry domain or organizational structure in which this concept is applied. The third is to collate and summarize the specified architecture of an SOBC platform along with their components or pattern found from the data extraction result. Fourth is to recap and summarize the technologies being used to enable the SOBC platform.

2.5.1. Motivations of Service-Oriented Business Collaboration Adoption

In order to address the question of motivations in the adoption of an SOBC platform, this review refers to the book by Lankhorst (2016), which explains the definition of Motivation as the reasons that influence and constrain the design of an enterprise architecture. In a shorter definition, they are the reasons behind the decision made in the architecture. From the practice of EA, this Motivation consisted of multiple concepts that are essential in further elaborating the discussion in this subsection. The first concept is the Driver, which is defined as the external or internal condition that motivates an organization to define its goals and implement the necessary changes. The Goal is quoted as the high-level statement of intent or desired end state for an organization. By establishing the Goals, a set of statements that are required in order to realize them, or known as the Requirements, should also be defined. The following Table 5 shows the identified Driver, Goal, and Requirements concepts from the extracted data which are followed by the references from which they were summarized from.

Table 5 Driver, Goal, and Requirements of SOBC adoption

No.	Driver	Goal	Requirements
1	Competitiveness	- Increase connectivity [P1, P21] - Reduce complexity [P20] - Increase customer satisfaction [P8, P15]	- Provide collaborative/shared platform/portal [P2, P8, P11, P15, P20, P21, P23, P29] - Enable information exchange [P1, P3, P8, P12, P21, P29] - Enable collaborative business processes [P3, P29] - Enable services orchestration [P8, P13, P21, P29] - Enable integrations of existing applications & systems [P4, P21, P29] - Implement SOA [P4, P17, P21, P29]
		- Facilitate collaborative functions [P5, P10] - Facilitate partnership formation & fulfillment [P2, P10, P11, P10, P23, P26] - Increase entrepreneurship & diversification in rural areas [P21, P23]	- Publish production capabilities [P2, P5, P10] - Publish time constraints capabilities [P5] - Enable negotiable price/cost [P5] - Enable supplier discovery [P2, P5, P10, P18, P26] - Enable products/services registration/catalog [P2, P8, P23] - Enable provision of financing/funding [P8, P13] - Enable feedback & reputation management [P10, P21] - Enable marketing, sales, orders [P2, P13, P18, P23] - Enable planning & forecasting [P13, P21, P26] - Enable transportation & logistics management [P18, P23]

2	Resource	- Lower entry & capabilities barrier [P2, P10]	- Provide collaborative platform/portal [P2] - Enable provision of financing/funding [P8] - Enable information exchange [P10]
		- Increase efficiency [P3, P10, P17, P18, P19]	- Enable information exchange [P3, P19] - Implement SOA [P17] - Provide collaborative/shared platform/portal [P17]
3	Profitability	- Increase income/profit [P3, P10] - Increase socio-economic growth [P21]	- Enable products/services registration [P10] - Publish production capabilities [P10] - Enable marketing & sales [10]
		- Decrease (development, deployment, operating, transaction) cost [P4, P29]	- Implement SOA [P4, P29] - Provide collaborative/shared platform/portal [P11]

The summary of the extracted data of the gathered literature articles has shown that the motivations of business entities adopting SOBC can be assigned into three main drivers. The first driver of Competitiveness is the most obvious reason that motivates the companies to establish a business collaboration between each other. Competitiveness is the resulting Driver from the external and internal circumstances of the current business ecosystem such as the increasing complexity of globalization as well as increasing demands to reduce product life cycles and time-to-market (Budinská et al., 2007). Another study from Lorré et al. (2006) also justified this by stating that purchasing through a group-buying platform is increasingly becoming the decisive competitive advantage within companies and among groups of companies.

These conditions have motivated companies to establish a set of goals in order to obtain a competitive advantage. The first set of these goals includes increasing connectivity among each other, which is realized by the requirements of providing a collaborative platform that facilitates information exchange, enables collaborative business processes, orchestrates specialized services with each other, and sets up integrations between existing application assets through SOA implementation. The second set of these identified goals includes facilitating collaborative functions between the participating companies, facilitate the formation of partnerships & fulfillment of the potential collaborative opportunities, and in the case of a rural business ecosystem, is to increase entrepreneurial initiatives and business diversifications. In order to realize this set of goals, a list of collaborative functional requirements has been shown in Table 5. Another study by Parikh et al. (2015) also concluded that providing an SOA-based collaborative platform for stakeholders in animal husbandry and dairy farm can increase entrepreneurship among the young generation and prevent rural-urban migration up to a certain level.

The second driver contributed to the adoption of SOBC is regarding the Resource. This driver derived from the typical condition in which the potential or to-be participating companies are strained over limited resources (capital, manpower, time, skill, and knowledge), thus limiting their capability in providing the necessary collaborative software. Lorré et al. (2006) and Svirskas et al. (2008) stated that smaller companies, such as Small and Medium Enterprises (SMEs), establish an engagement in value-added partnership supported by collaborative software solution mostly caused by their smaller capital and lower computer technology skills in order to invest into ICT services. It is also outlined in their study that a

goal-driven consortium, called Virtual Organization in their study, is able to provide higher efficiency of transaction cost for SMEs. Moreover, through pooling and complementing their resources together, it is believed that these companies can achieve the required business agility and competitive advantage against the larger corporations. Based on the referenced studies, these goals of lowering the barriers and increasing efficiency can be addressed by providing a collaborative platform that enables information exchange and, in some cases, enable financing/funding provision that is designed under the architecture of SOA.

Another driver is Profitability, as it is one of the main objectives for companies to achieve in order to keep sustainable. This driver concerns about achieving goals of increasing income or profit while at the same time reducing cost as extensible as possible. Svirskas et al. (2008) argue that by bringing together the resources and competencies between participants in a collaborative business ecosystem, previously unreachable market opportunity can be fulfilled, thus generates additional revenue source. Also, as mentioned earlier from the study of (Parikh et al., 2015), a positive impact on socio-economic growth can be realized through the increased entrepreneurship level in a rural region.

2.5.2. Applied Domains of Service-Oriented Business Collaboration

Most of the studies gathered from the selected articles have mentioned that the concept of SOBC is mostly applied to the domain of Supply Chains Management (SCM). However, due to the vast business implementation of SCM studied in the selected research articles, several more specific domains are further categorized. Moreover, another domain where this topic is being applied is also noted out. These domains and their specialized implementations if there are any, along with the article references that their implementations are being studied upon are listed in Table 6 below.

Table 6 Applied Domains of SOBC

No.	Applied Domain	Sub-Domain
1	Supply Chain Management [P1, P2, P12, P13, P19, P23]	Farming & Rural Development [P21, P23]
		Manufacturing [P2, P5, P10, P11, P14, P16, P17, P18, P26]
		Logistics & Warehousing [P1, P4, P5, P15, P18]
		Retail [P1, P18, P23]
2	Tourism [P8, P12, P23, P29]	
3	E-Commerce [P3, P24, P27]	
4	Banking & Finance [P8, P18, P25]	
5	Government [P20, P22, P24]	
6	Health Care [P6, P24]	
7	Science & Education [24]	

As stated earlier, these identified domains are mostly dominated by applications in SCM. This domain can be further categorized into a set of more specific implementations, which consist of business in Farming, Manufacturing, Logistics & Warehousing, and Retail. Multiple manufacturing industries were identified proposing service-oriented solutions for

business collaboration. An et al. (2012); Lorré et al. (2006); Svirskas et al. (2008); Tektonidis et al. (2008); Wang et al. (2018); Zhu et al. (2010) have shared a common substance in their studies, which is to propose an SOA based collaborative platform for use among SMEs in manufacturing industry engaged with their partners. Similarly, the application of a Service-Oriented based Collaborative Platform has also been suggested by An et al. (2012); Xu et al. (2010); L. Zhang et al. (2006), which in their studies is applied in the logistics industry. However, An et al. (2012) extended the application of this similar in characteristic collaboration platform, by coordinating the services of Sales, Production, Logistics, and Finance using a unified control mechanism.

Another applied domain identified is the Tourism industry, followed by E-Commerce, Banking, and Finance, Government. The tourism industry shares a similar characteristic with SCM by also involving participations from multiple types of business in their value chain such as tour agencies, airlines, hotels, rentals (Yuhui, 2008), etc. Banek et al. (2008) believed that the key step to improving the e-Business in Croatian tourism was to provide a tourism portal where service and product providers can register their services/products and offer them publicly to a user-friendly interface. Smari et al. (2006) have proposed an architectural framework for collaborative e-commerce. However, the latest study about the implementation of an SOA-based integrated e-marketplace platform that enables interoperation between multiple e-marketplaces has been proposed by Ismanto et al. (2019). The same approach has also been applied to the financial technology industry previously, where an integrated application platform based on SOA capable of combining financial statements of all integrated banks and generating a composite report through the use of web services is proposed (Suryatmojo et al., 2018). Similarly, this approach has also been applied to governmental sectors where an interoperable SOA-based architecture e-government portal is needed to provide a one-stop seamless access solution for the citizens, business, and tourists.

In the context of rural development, Parikh et al. (2015) have proposed a collaborative platform based on SOA in the livestock farming sector, while Schaffers et al. (2016); Uhryn et al. (2020) have proposed an SOA based collaboration platform to be implemented and applied to the rural business ecosystem where a variety of business domains ranging from fisheries, retail, tourism, and agriculture are the major economic driver. To capture the three different elements that influence the technology adoption decisions in an enterprise, the Technology-Organization-Environment (TOE) framework is referred (Baker, 2011; Tornatzky et al., 1990). Schaffers et al. (2016) has shown that the study of SOBC in the context of rural development was driven by the limited availability of technological infrastructure despite the eagerness of a large number of small to micro-entrepreneurs, business associations, and local policy makers to form a collaboration initiative. Meanwhile, Parikh et al. (2015) have noted that the demand in economic growth followed by the scarcity of information availability as well as information utilization between stakeholders in the livestock farming sector were the notable stimuli towards the needs for collaborative technology intervention. These findings imply that the limited access towards business supporting technology as well as collaboration enabler technology has been the focal constraint towards the technological adoption maturity in the rural business ecosystem that can contribute to their economic growth and competitiveness development. This limitation also imposes the higher challenge that the potential participants will encounter when they have decided to establish a collaboration initiative.

In contrast to the previous findings, other industrial domains that have been frequently studied, such as Manufacturing, Logistics & Warehousing in Supply Chain Management, have

shown that their higher level of maturity in technological adoption is mainly contributed by the availability of their existing or legacy business supporting technologies due to their larger capital, higher network, higher demand and higher capability and knowledge (Budinská et al., 2007; Wang et al., 2018). Tektonidis et al. (2008) have also noted that a major part of the ICT applications market for business in Europe was dominated by large multinational actors that focus mainly on the high-end market segment, which has reached their maturity in technological adoption. Moreover, a study conducted by Banek et al. (2008) has also described that the success of the implementation of SOBC in Croatian tourism is due to the recognized advantages of e-business by large Croatian retailers, banks, telecommunication operators, and companies involved in other commercial areas. Overall, these discoveries have made certain that the concept of SOBC has been applied to a diverse set of domains ranging from production and manufacturing sector, logistic, retail and commerce, banking and financing as well as government

2.5.3. Service-Oriented Business Collaboration Architectural Layers & Components

Multiple SOBC architecture models can be identified from the selected studies along with the components or patterns specified in them. However, a set of similar properties in relevance with the concept of SOA can be identified from them. Lankhorst (2016) has stated that typical service-oriented enterprise architectural design may lead to a layered view of the enterprise architecture model. Based on this, common architectural layers based on SOA can also be extracted subsequently from the studies. The following Table 7 presents the common architectural layers that can be found from the selected studies revolving in the concept of SOA.

Table 7 Architectural Layers in Service Oriented Business Collaboration

No	SOA Layers	Descriptions
1	Presentation [P2, P8, P9, P13, P15, P16, P19, P20, P21, P22, P27, P28]	A layer that provides users with a consistent interface such as a Web-Based portal or Mobile Application. This layer ensures that all users can access and seek the service requested in a unified way (Xu et al., 2010).
2	Value Chain [P12, P13, P18, P19]	Comprises of business processes that are opened and combined with other enterprises across organizational boundaries (Yuhui, 2008).
3	Business Processes [P2, P9, P12, P14, P15, P16, P19, P28, P29]	Functional integration that groups and orchestrate (business) services from the underlying business service layer into a flow of business activities (Wolfert et al., 2010; Yu et al., 2010).
4	Integration [P2, P7, P9, P15, P16, P17, P18, P19, P22, P24, P25, P27, P28]	Integration of services through the introduction of intelligent routing to the proper target, protocol mediation, and other necessary transformation mechanisms facilitated by Enterprise Service Bus (ESB) (Yu et al., 2010).
5	Services [P2, P4, P9, P12, P13, P14, P15, P16, P17,	Describes the implementation of information processing functions of the business processes and how business data transferred from one system to another system of

	P18, P19, P20, P21, P27, P28, P29]	enterprises through publishing reusable application components for information interoperability between entities (Ismanto et al., 2019; Jiang et al., 2012; Wolfert et al., 2010).
6	Applications [P4, P12, P13, P14, P15, P16, P17, P19, P20, P24, P27, P29]	Describes the encapsulation of existing applications using typical component-based technologies offering a standard web service interface to the business services (Wolfert et al., 2010; Yu et al., 2010).
7	Technological Infrastructures [P16, P17, P19, P22, P24, P28, P29]	Describes the underlying involved technologies such as Operational Systems, Networking, Databases, and Data Center Servers, etc., and their structures in supporting business applications and services.

However, even though these selected papers have presented architectural layers of their solutions based on SOA, inconsistencies, and redundancies in their architectural design decisions of each layer between each research study are identified. An example of these inconsistencies is the existence of the Integration Layer in conjunction with the layers of Applications and Technological Infrastructures since the integration of services is also the realization of integration of applications. Other layers, such as between Presentations and Applications or between Value Chain and Business Processes, are also overlapping with each other due to their tendency to ambiguate each other existence based on their involved components. Moreover, the extracted SOA layers in Table 7 also tends to only limit the architectural view of Applications and Technological Infrastructures in realizing Services to orchestrate Business Process. This implies that strategic and motivational aspects of the business collaboration have not yet been integrated into this architecture, which should be essential for the sake of optimizing Business and IT alignment for different perspectives of the whole enterprise.

Table 8 Identified SOA Layers Translated into ArchiMate Layers

No.	ArchiMate Layers	Identified SOA Layers
1	Strategic	(not identified)
2	Motivation	(not identified)
3	Business	Value Chain
		Business Processes
		Services
4	Application	Presentation
		Integration
		Services
		Applications
5	Technology	Integration
		Technological Infrastructures
6	Physical	(not identified)
7	Implementation and Migration	(not identified)

To facilitate a more comprehensive approach in designing an Enterprise Architectures, the use of ArchiMate language full framework as explained in Section 1.4.2 will be advantageous in this case since it supports the architectural layers of Strategy and Motivation

as well alongside Business, Application, and Technological layers (Lankhorst, 2016). Table 8 illustrates the translation of the extracted SOA layers into the corresponding ArchiMate Layers. It is observable that by integrating the overlapping SOA layers, such as the Value Chain and Business Processes, into a single Business Layer in ArchiMate, a more concise and less ambiguous architectural layer can be achieved. Moreover, through this translation, the layer of Services from SOA can be further specialized into the Services concept in the Business, Application, and Technology Infrastructure layers of ArchiMate. This action is taken in order to facilitate different perspectives of Services between different stakeholders in an enterprise, such as between the perspective of higher managements who concerns more towards services offered to the customers or partner and the perspective of application developers who concerns with the application services to support application integrations. Along with this, this decision also enables cross-layer dependencies that represent the relation between Business, Application, and Technology Infrastructure layers, which is further promoting the alignment of Business and IT (Nardi et al., 2016).

Aligned with the definition of SOBC that this paper has put forward earlier, Lankhorst (2016) also noted that the Service concept plays a central role in the service-oriented enterprise architectural design and its layering. A Service is defined as a unit of functionality that some entity makes available to its environment and provides value for certain entities in the environment which is known as the service consumers. In order to be externally or internally operationalized, Business Services is first internally realized by a set of Business Behaviors, which, one of them among others is by a set of Business Functions. A Business Function groups behaviors based on required skills capabilities, resources, or application support (Lankhorst, 2016). Since ArchiMate architectural layers have been listed in Table 8, a set of Business Functions and their relevant business behaviors which belong to the Business Layer extracted from the curated studies is listed in Table 9 below.

Table 9 SOBC Business Functions and Relevant Behaviours

No	Business Functions	Relevant Behaviors/Activities
1	Ordering & Sales [P1, P2, P13, P18, P23]	Request Order Detail [P1]
		Place Order [P23]
		Confirming Purchase [P1]
		Confirming Sales [P1]
		Set Purchase Rules [P2, P9, P11]
		Negotiate Purchase Rules [P2, P9, P11]
2	Production & Procurement [P2, P13, P18, P23]	Register and Update User/Buyer/Seller [P8, P11, P13]
		Register and Update Product/Service [P8, P9, P11, P13]
		Search/Request Seller [P2, P11, P13]
		Select Seller [P2, P13]
		Search/Request Product/Service [P2, P8, P13, P14, P23]
		Select Product/Service [P2, P13, P23]
3	Warehouse/Stock Management [P23, P27]	Request Stock Detail [P27]
		Update Stock Detail [P27]
		Notify Stock Changes [P27]
4		Place New Shipping [P28]

	Distribution & Logistics [P1, P13, P14, P18, P23, P27, P28]	Shipping Preparation [P1]
		Shipping [P1, P14]
		Receiving Preparation [P1]
		Receiving [P1, P14]
5	Payment, Settlement & Financing [P1, P8, P13, P18, P27, P28]	Request/Send Quotation/Invoice [P2, P14, P28]
		Authorize Payment [P27]
		Confirm Debt/Credit Settlement [P1]
		Confirm Payment [P1, P27]
		Apply & Close Financing [P8]
6	Marketing [P13]	Product Promotion / Service Proposition [P25]
7	Reputation [P11]	Submit Product/Service Reputation [P11]
		Submit Seller/Buyer Reputation [P11]
8	Data Analysis [P8, P25]	Request Sales Reporting [P25]
		Request Finance Reporting [P28]

As concluded in the previous section, the relevance of the curated Business Functions and their relevant business behaviors is closely related to the domains of the production and manufacturing sector, logistics, retail and commerce, banking and financing as well as government. Hayashi et al. (2005) proposed a pattern involving collaborative activities among participants in the retail industry which consists of Business Functions that realize the Business Functions of Ordering, Distribution, and Account Settlement. Complementary to the previous case, Lorré et al. (2006) have proposed a set of collaborative activities in a group-buying portal for SME clusters, which mainly discuss about providing business functions of Procurement and Supply Management, Order Management, and Partnership Management.

Meanwhile, Li and Englert (2010) went beyond Ordering, Procurement, Distribution, and Account Settlement by expanding their Collaborative Business Model into covering business functions of Marketing and Financial Collaboration Management. Sofian and Albarda (2019) have complemented the business functions of Settlement & Financing by emphasizing the Payment service where it contains activities such as payment verification and approval. Tektonidis et al. (2008) have suggested that Business Function such as Reputation Management that is connected to the portal via web services is substantial in providing information about the reliability and expertise of potential partners. Meanwhile, Banek et al. (2008) have argued that the provision of Business Analysis through shared collaborative data is the central point to seize the market competition along with the provision of support from the government such as in the form of Financing. These findings conclude the discussion towards rediscovering the architecture of Service-Oriented Business Collaboration present in the selected studies. Components related to the architectural layer of Business in ArchiMate have also been identified and elaborated, and the ones related to the layers of Applications and Technological Infrastructure will be discussed in the next section.

2.5.4. Service-Oriented Business Collaboration Technology Enablers

This subsection discusses the type of technology used in the Service-Oriented Business Collaboration platform that has been extracted from the selected studies. Multiple studies have mentioned the provision of a web-based portal or take in the form of a mobile application. Some studies have suggested the use of technologies that are based on open-source standards, while others have proposed a set of solutions that are developed and

offered by renowned IT vendors. Table 10 below shows the list of technologies that are used in a typical SOBC platform implementation and being listed under the architectural layers of ArchiMate, which involves the Applications and Technological Infrastructure.

Table 10 SOBC Integration, Applications and Technological Infrastructure Components

No.	Layers	Category	Technology
1	Applications	Portal User Interface	- Web-Based [P2, P8, P9, P11, P19, P20, P21, P22, P24, P27] - Mobile Application [P8]
		Messaging Format	- XML and ebXML [P1]
		Web Service Standards	- SOAP [P4, P7, P12, P19, P20, P24] - REST [P20, P24, P28]
		Communication Model/Message Patterns	- Request-Response [P9, P21] - Publish-Subscribe [P9]
2	Technological Infrastructure	Service Orchestrator, Application Integration Middleware	- Enterprise Service Bus [P2, P4, P7, P8, P9, P14, P16, P19, P22, P24, P27, P28] - Services Gateway [P9] - Message-Oriented Middleware [P24]
		Databases	- MS-SQL [P22] - Oracle DB [P22] - PostgreSQL [P22] - MySQL [P22]

Most of the selected studies were emphasizing on the use of Enterprise Service Bus (ESB). Lorré et al. (2006) has used Petals ESB technology in supporting the integration of affiliated information system and orchestration of services. Meanwhile, Deng et al. (2008) have mentioned IBM WebSphere as one of the application and integration middleware solutions offered by renowned IT vendors. This middleware solution has also been brought up by Wolfert et al. (2010) along with other middleware solutions offered by IT vendors such as Oracle Fusion, Microsoft BizTalk, SAP NetWeaver, Tibco, etc. Other middleware technologies that are provided to developers as an open-source software solution such as WSO2 are also observable in these studies, as Kurniawan and Ashari (2016) have presented how they configured the mediators of the ESB to facilitate necessary data transformation mechanisms. In addition, Delgado et al. (2018) have involved ActiveMQ as their Message-Oriented Middleware (MOM) in their prototype implementation technological architecture, though they have not elaborated their justification for this decision.

The decision towards the use of other categories of the identified technologies is also extracted from these studies. Initial studies have shown that SOAP is the preferred Web Service Standards to be used (Jiang et al., 2012; Svirskas et al., 2007; Yuhui, 2008; L. Zhang et al., 2006). However, more recent studies have shown its trend in using REST APIs (Delgado et al., 2018; Sedek et al., 2012; Sofian & Albarda, 2019). Finally, these results concluded the discussion in the search of the type of technologies being used in a typical Service-Oriented Business Collaboration platform. However, these results obtained from the selected studies could still possess gaps compared to the latest implementations in the industry due to their discussion that is more focused on enabling the business collaborations along with the limited space in their studies.

2.6. Service-Oriented Business Collaboration Reference Architecture

This section aims to construct a Service-Oriented Business Collaboration reference architecture that is analyzed and derived from the findings gathered from the systematic literature review. The review is conducted by exploring the latest development in service-oriented business collaboration, specifically, to gather the motivations in its adoption, the industrial domain that the concept is being applied, the architectural layers and components that are involved, and utilize technologies that act as its enabler. Based on the findings and analysis in the previous sections, the reference architecture as shown in Figure 7 is proposed.

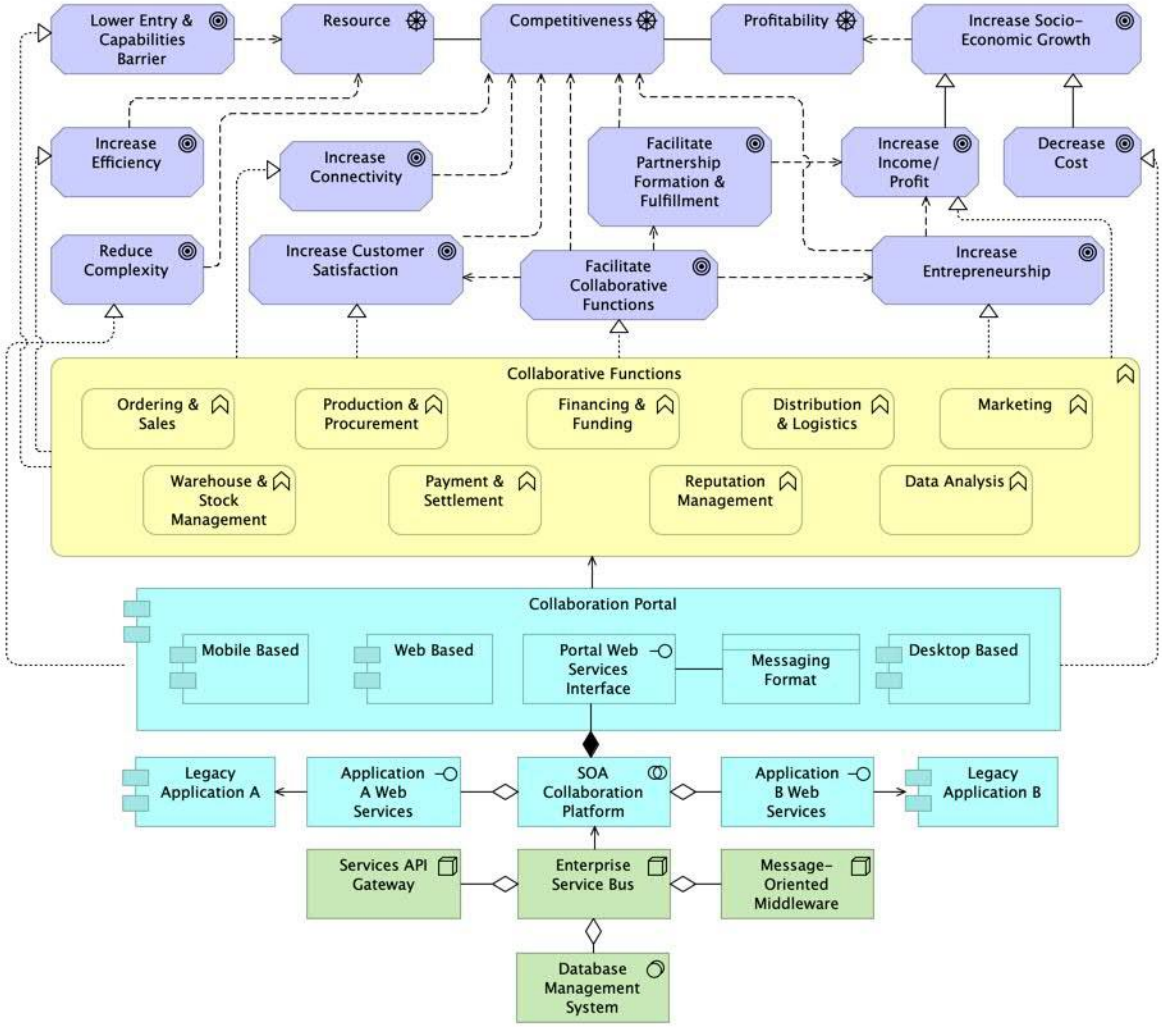

Figure 7 Service-Oriented Business Collaboration Reference Architecture

This reference architecture is modeled using ArchiMate since it is one of the proven modeling languages for designing enterprise architecture in numerous real-life practical case studies (Lankhorst, 2016). The design of this reference architecture is based on the result analysis carried out in the previous sections, which is aimed to answer the first research question of this research. Based on the translation of SOA into the ArchiMate architectural layers in subsection 2.5.3, 4 architectural layers that consist of Motivation, Business, Application, and Technological layers are identified. This addition of the Motivation Layer

complements the missing link between the extracted SOA layers and the motivational aspect that the participants of a value network aim to achieve when they establish their business collaboration.

In subsection 2.5.1, 3 main Drivers that motivate business entities to establish SOBC initiatives with value partners have been identified. These drivers consist of Competitiveness, Resource, and Profitability. The success of these Drivers is being influenced by a set of goals that are listed in the earlier Table 5. Additionally, some goals are also identified to be influential to the other goals as well as being a specialization of a higher generalized goal such as the goals that influence the Profitability Driver. A set of identified Requirements that contributes to the realization of these Goals have also been listed in Table 5. However, these Requirements are not illustrated in this reference architecture in order to avoid an overly complex model.

The second layer is the Business Layer, which in this reference architecture is constituted by Business Functions. This layer is derived from the result analysis conducted in subsection 2.5.3, in which the Business Functions and their relevant behaviors are identified from the curated studies of typical SOBC initiatives. These Collaborative Business Functions should be able to realize the expected Goals that the participants of a value network desire to achieve. An example of this is through the provision of Collaborative Business Functions in a business collaboration environment, a value-added partnership formation to tackle business opportunities that exceed individual participants' capabilities can finally be facilitated (Svirskas et al., 2008). Correspondingly, through the realization of this goal, the goal of increasing their income and the Competitiveness as well as Profitability drivers will also be positively influenced.

The third layer that constitutes this reference architecture is the Application Layer, in which it supports the Business Layer with application services realized by application components (Lankhorst, 2016). The Application Layer in this reference architecture is composed of Application Components, Application Services, and Application Collaboration constructs. Real-world implementation of the elements in this layer is diverse. However, common concepts derived from the selected studies have been listed in subsection 2.5.4 and able to be identified in this reference architecture. Examples of these concepts are the provision of Collaboration Portal applications (e.g., Web-Based, Mobile Based, or proprietary Desktop Based applications) and the integration with other existing/legacy applications through the SOA Based Collaboration Platform using Web Services technology. Other elements have also been identified such as the messaging format and web-service standards used for communication between applications, but these decisions mostly dependent on the current trends or technical requirements in the industry and are independent with the decision to align with the Service-Oriented Architecture.

The fourth layer, which supports the third layer, is the Technology Layer. This layer offers infrastructural services such as processing, storage, communication, and system software needed to run the applications (Lankhorst, 2016). The commonly identified elements that support application integrations and collaboration platforms in typical SOBC initiatives are mostly about the provision of ESB, as explained in subsection 2.5.4. Other elements that are aggregated to work together with the ESB are the deployment of Database Management System, along with Message-Oriented Middleware and Services API Gateway. However, the provision of the late two elements is dependent on the IT vendors and they either come bundled together with the ESB or are not yet provided as a default.

3. SOBC Platform for Rural Business Ecosystem Reference Architecture

Following the identification of the SOBC Platform reference architecture that has been done in the previous chapter, an investigation to specify and design the reference architecture of SOBC Platform for rural business ecosystems is then to be carried out. Based on the framework to analyze and design a software reference architecture by Angelov et al. (2012), the first step is to state the goal, application context, and the timing aspects of the architecture. This step ensures that the reference architecture being designed will meet the precise interpretation by the potential stakeholders of the reference architecture. The process is then further carried on by designing and specifying the architectural components according to the framework by Nakagawa et al. (2014) that has been previously discussed as the integrated reference architecture design framework in Section 1.4.3.

3.1. Architecture Goals Definition

The first concern in designing the reference architecture of an SOBC platform for rural business ecosystems is to define the architecture goal. In this step, the question of "Why" this reference architecture is being defined needs to be answered. As stated by Angelov et al. (2012), two possible values can be distinguished in classifying the goal of a reference architecture. The first one is as standardization of concrete architectures that aims at system/component interoperability, and the second is as a facilitation of the design of concrete architectures that aims to provide guidelines and inspiration for the design of systems. Since the objective of this research is to provide a baseline model that can be used by researchers or practitioners to design a business collaboration platform for rural business ecosystems that follows the principles of SOA, then this reference architecture to be designed falls under the facilitation category.

The need for a business collaboration platform for rural business ecosystems that follows the principles of SOA comes from numerous factors. Among all of the factors, one of them is the high saturation of low value-added production activities and the reduced level of information technology support in some of the population that makes local businesses in rural areas suffer from a lack of competitiveness (Cunha et al., 2020). Parikh et al. (2015) noted that the reduced degree of information technology support and information synchronization among each other raises the necessity to collaborate between stakeholders in order to enable a higher level of value-added production activities. However, based on a SWOT analysis of ICT development in rural performed by Sari et al. (2018), it is discovered that budget constraint is one of the inhibiting factors of ICT development in rural areas. This causes a limitation to the capability of value-adding activities and accessibility towards market information, sales channels, and funding source. Moreover, there is an observable ignorance and absence of synergy between governmental agencies and 3rd party enterprises that possess the authorities and resources or capabilities to initiate and administer IT-enabled business collaboration with rural business communities (Cunha et al., 2020; Sari et al., 2018).

In order to improve this situation, some preliminary actions are required. Due to the budget and authorities possessed by the governmental agencies, their role is to initiate the development and provision of ICT facility and the infrastructure for a collaboration platform that enables business collaboration between itself, 3rd party enterprises, and rural business

communities. Furthermore, their role to enforce and maintain close cooperation with each other is also crucial for this initiative (Friedland et al., 2008). Through the previous systematic literature review, it is discovered that due to the potential size and high flexibility of these rural business communities, the larger and more IT-capable highly specialized enterprises are starting to consider the value in establishing a collaborative value network among each other. Lulu (2019) has identified that by providing value-adding services such as facilitating transactions on an online platform, IT-based enterprises operating in an online-based platform such as e-commerce of late may gain extended market penetration and diversify their sources of profitability. Taking this observation into account, these 3rd party enterprises may bring shared benefits to each other by exposing and providing their specialized resource and capabilities to participate and collaborate in this initiative. Meanwhile, from the perspective of the rural business entities is to expose their specialized competencies and take advantage of this collaboration platform initiative in order for them to gain access to funding sourcing, procurement sourcing as well as market sales channel.

Taking this situation into account, an ICT solution in the form of an SOA-based collaboration platform that aims to increase information and business process connectivity, market sales and funding source accessibility is becoming a necessity. Due to its possibilities to be scalable and extendable in response to the availability and participation of the service providers, an infrastructural design decision that adheres to Service-Oriented Architecture is necessary for realizing this initiative. Since a cross-enterprise application integration that involves inter-organizational business processes and services orchestration will take place in this rural development business collaboration initiative, the need for an integration reference architecture to gain a clear understanding of the future information systems architecture and to facilitate the implementation of new business processes across heterogeneous enterprise applications intermediated by enterprise service bus is needed (Puschmann & Alt, 2004; Themistocleous & Irani, 2003). Thus, the goal of the reference architecture to be developed in this research is to be paraphrased to deliver a reference architecture in provisioning an SOA-based business collaboration platform that aims to increase information connectivity, inter-organizational services orchestration, and heterogeneous enterprise applications integrations for the context of rural business collaboration ecosystem.

3.2. Intended Application Context

The next concern following the architecture goal is regarding the intended application context of the designed architecture, in which the questions of “Where”, “When” and “Who” should be answered (Angelov et al., 2012). First of all, the dimension of “Who” defines the designers that were involved in the construction of this reference architecture. In the case of this research, the obvious designer is me as the author of this research itself. However, taking this fact into a broader perspective, the design team that can be responsible for the construction of this reference architecture may take the form of a research group, research body, or research institution.

Secondly, the sub-dimension of “Where” attempts to describe the stakeholders or recipient organizations at which this reference architecture is intended to be applied for the design of the concrete architecture. Even though a reference architecture can be designed with the scope of a *single organization* in mind, this reference architecture, in particular, is designed to be applied to *multiple organizations* that share a common goal in establishing and enriching an SOA-based rural business collaboration platform with a set of collaborative

business functions. As described in the earlier section, the said *multiple organizations* may take the form of government agencies who have the right to allocate necessary budget to enforce the work program that concerns the connectivity and cooperation among business entities, 3rd party enterprises who possess the resources and capabilities to offer collaborative business functions into this IT-enabled business collaboration, and rural business entities who are able to expose their specialized competencies and participate in this collaboration platform initiative. Moreover, the scope of the said rural in this research is the region that possesses a lower population density (compared to urban), a high concentration of production in low added value activities, and a reduced degree of information technology use in most of its business segments (Cunha et al., 2020).

Thirdly, the question of "When" addresses the timing that this reference architecture is being designed. A reference architecture may be classified as a *classical reference architecture* when substantial best practices with a number of different concrete systems are available. Even though a number of studies that discuss rural development or rural business collaboration ecosystem have been conducted previously, rarely have proposed a concrete architecture that takes the paradigm of EA and strategic business-IT alignment into consideration. Based on this reflection, classifying the reference architecture proposed in this research as a *classical reference architecture* will be risky.

Hence, further analysis is required to better classify the reference architecture under discussion in this chapter. Among other research articles that study business entities' collaboration in a rural context, Friedland et al. (2008) have proposed an architecture of collaborative procurement model for networked micro-enterprises in rural South Africa, which is the most related artifact as the one being discussed in this chapter. However, this architecture tends to be limited to the identification of the involved stakeholders in value-adding activities in a network of micro-enterprises and lacking the elaboration on the orchestration of business processes and business services among each other. Due to this, consideration regarding the fact that the algorithm or architecture best practices needed for this application have not yet sufficiently proposed by the time that this study is being carried out justifies that the reference architecture is proposed in this research can be classified as a *preliminary reference architecture*. Based on the defined goals earlier and this application context specification, this reference architecture can be matched with the reference architecture variant of Type 5, which is a *preliminary*, *facilitation architecture* designed to be implemented in *multiple organizations* according to the description in Section 1.4.3 previously.

3.3. Architecture Design and Specification

This dimension consisted of sub-dimensions concerning the type of information being included, the possible level of detail at which the elements are being defined, the level of abstraction, and the level of formality of the reference architecture. Since this reference architecture is categorized as a Type 5, it has to be detailed or at least semi-detailed in a sense that is able to provide details for the innovative aspects and the implementability of the architectural components and design decisions (Angelov et al., 2012). Furthermore, this type of reference architecture should also be an abstract architecture and designed as a formal or semi-formal architecture. This means that the components contained in the architecture are specified in terms that generally specify its functionality and the representation of the architecture is based on a well-defined notation or modeling language such as ArchiMate for

EA modeling. The identification of the type of information or components to be included in this reference architecture, however, will follow the guideline used by Nakagawa et al. (2014); Rohling et al. (2019) as stated earlier and will be discussed in the following subsections.

3.3.1. Architecture Requirement Analysis

The first two steps to initialize the ProSA-RA framework are to investigate information sources and identify the architectural requirements of the reference architecture. In order to obtain the relevant requirements of the reference architecture for an SOA-based rural business collaboration platform, the information is being investigated from research publications that have a study focus on business development and collaboration in a rural context. Furthermore, the selected research articles for SLR in the previous chapter that are relevant to the study of rural business collaboration in this section, are being referred again to align with the guideline suggested by Nakagawa et al. (2014); Rohling et al. (2019) for this requirement analysis.

According to the previously defined architecture goal and stakeholders (recipient organizations at which this reference architecture is intended to be applied) in the earlier sections, the focal concern of the rural businesses that constrains them in achieving economic welfare is related to the low competitiveness level of their business. Mukti et al. (2020) have proposed that in order to improve competitiveness in a rural context, the implementation of rural smartness is required. This rural smartness is being referred to as the situation where the facilitation of IT infrastructure and IT services can empower rural citizens in improving their welfare.

However, Parikh et al. (2015); Schaffers et al. (2016) noted that the focal reason behind the rural businesses' deficiency in achieving economic welfare is caused by the limited access to business supporting and collaboration enabler technology available to them. These access limitations manifested in the form of limited digital literacy and resource (budget or capability) limitations, which in turn, are being considered as a high entry barrier from the perspective of the rural businesses. This issue contributes towards the reduced degree of information connectivity among their peers, which also hinders them to find potential partners. In relevance with information connectivity, Lusch and Nambisan (2015) suggested that in order to foster service innovation, a service platform that can facilitate collaborative information and service exchange between actors in a network is essential. This suggestion then marks the conjecture that a service platform is an integral component in the development of rural businesses since it enables them to digitize their offerings, decouple the information from their isolated environment and form a collaborative value chain.

Although the need for a rural business service platform is perceived to be compulsory, in practice, the budget for its provision is under a constrain. This is due to the fact that most of the time, the responsibility to initiate the initiative is being carried over by the government agencies in charge and the existence of other pressing matters binds their budget expenditure on IT services and infrastructure (Sari et al., 2018; Talbot, 2016). Naturally, their competencies to develop relevant IT services with the needs of the rural businesses to compete in the industry is also at risk of being inadequate due to their non-profit-driven initiative. In respect to this, the said competencies can actually be identified to have been grown mature by the 3rd party IT-based enterprises that are competing in the industry, such as enterprises that are competing in e-marketplace and tourism reservation industry. In this case, the involvement of a government entity to initiate the provision of essential IT services for rural businesses

and enforcement of collaboration with 3rd party service providers is then perceived to be crucial in order to provide the essential IT services efficiently.

In relevance with provisioning the essential IT services for rural businesses, Cunha et al. (2020) stated that, lately, rural regions are already in the effort to tackle economic and business development challenges that are related to business cooperation networks, ICT-enabled precision agriculture, ICT-enabled tourism, and Digital Marketing. Subsequently, a study based on interviews and observations on rural community representatives suggested that there is a demand for a collaborative platform that can support information for their livelihood (or sustenance) such as the market price and availability information for the procurements of equipment and raw material, the market price for the production of their local communities as well as the market commodity price (Sari et al., 2018). It is also demanded that this platform can support promotion for their local produce, competencies, and tourism to the potential customers in order to gain a higher level of market access.

In addition, Naldi et al. (2015) have argued that in order to achieve smart growth in rural areas, the development of the regions' potential specialization that takes into account the characteristics of local diversity should be administered. This is due to the fact that different regions may possess diversified economical activities that are corresponding to their varying business traits and needs. In relevance with diversified economical activities, Cunha et al. (2020) also suggested that the promotion of information regarding heritage, cuisine, natural beauty, and ancestral traditions from the rural regions is essential. This is vital for rural regions to be able to showcase their regional uniqueness to the potential customer or investor. Moreover, through this approach, a clarity towards tourists' preferences and satisfaction for the tourist attraction in the local rural region will come to the surface and open the possibility for extended data analysis to further increase the competitive advantage.

Correspondingly with product and service registration, the ability to manage and fulfill incoming orders from various sales channels is highly regarded by Schaffers et al. (2016) to bring a positive impact towards rural business development. However, due to the numerous and diverse sales channel platform that are existing recently, which may cause redundancies in the business processes perceived by the rural businesses as the users, an SOA-based platform that facilitates the management of various E-Marketplace platforms is deemed necessary (Ismanto et al., 2019). In order to facilitate the realization of this SOA-based platform, which emphasize the integration of multiple application components and the orchestration of their application services, the use of ESB has become the standard best practice among publications (Delgado et al., 2018; Ismanto et al., 2019; Suryatmojo et al., 2018).

Zavratnik et al. (2018) have noted that in applying the concept of Smart Village, an effective public-private-community partnership and access provision to funding mechanisms are requisite. Banek et al. (2008) have suggested that participation from the government in providing financial or funding aid to an individual business entity should be encouraged in order to contribute to the success of the business collaboration initiative. However, funding from the government is often inadequate and unavailable at times to support varying investment activities of the businesses in the rural community. Obviously, a private financing company will have the resource and capability to financially support the requirements of local rural businesses, but it will lack the participation and connectivity from the local communities.

Sari et al. (2018) have made clear that direct access towards a funding source, without a commission-based intermediary broker agent, is essential for these smaller business entities to secure the required capital for their business. This is in conjunction with what a

crowdfunding solution may offer. Crowdfunding is the process to raise a smaller amount of funds from multiple investors willing to finance the development of a project or business entity, and Temelkov and Gulev (2019) have suggested that crowdfunding platforms provide the means to eliminate the need for an intermediary in obtaining funds through the conventional financial source. Thus, in this case, partnership with crowdfunding platforms should be the best approach in order to raise the sustainability development of the local business in rural communities through extended connectivity and participation between all of the stakeholders.

3.3.2. Architecture Design Synthesis

In this step, previously identified architecture goal, intended application context, and architecture specification are being translated and synthesized into a set of enterprise architecture models. The models are being represented in ArchiMate modeling language as described in section 1.4.2 earlier. In order to narrow down the scope of interest of the target stakeholders of the reference architecture being discussed in this section, 6 architectural viewpoints are synthesized and proposed accordingly.

Rural Business Collaboration Motivation Viewpoint

As demonstrated by Nakagawa et al. (2014); Rohling et al. (2019), all of the discussed requirements in the previous sub-section are being listed as Architecture Requirements in the following Table 11 below. Nakagawa et al. (2014) also suggest that, in order to come up with the architectural requirements, a set of system requirements that may be comprised of functional or non-functional requirements envisioned for the software systems in the application domain should be identified beforehand. Furthermore, these requirements are being grouped according to what Tornatzky et al. (1990) have suggested that the adoption and implementation of Business-IT innovation within the context of an organization should be structured accordingly to the technology-organization-environment (TOE) framework.

Table 11 System and Architecture Requirements

No	System Requirement	Architecture Requirement	Group
1	The ability for the rural business entity to register for a user account	Facilitate digitization of rural business ecosystem	1
2	Access for the rural business entity to register local products or services to the platform		
3	Access for rural business to register funding request to the platform		
4	The ability of the rural platform to integrate with 3rd party marketplace platform	Provide access to marketplaces	2
5	The ability for the rural business to manage incoming sales orders from 3rd party marketplace platform		

No	System Requirement	Architecture Requirement	Group
6	The ability for buyers to discover local products or services from both rural platform or 3rd party marketplace platform		
7	The ability for buyers to settle transaction through 3rd party marketplace platform		
8	The ability of the rural platform to integrate with 3rd party funding platform	Provide access to funding sources	
9	Access for rural business to apply funding request to 3rd party funding source		
10	The ability for the rural business to provide and publish their business description to support the funding request		
11	Access for the local citizen to participate in an online crowdfunding initiative		
12	The ability of the rural platform to integrate with 3rd party tourism platform	Facilitate promotion of rural amenities	
13	Access of the rural platform to register and promote local tourism to 3rd party tourism portal		
14	The ability for tourists to discover local tourism, produces, cuisine, accommodation, heritage, and traditions		
15	The ability for the rural business to synchronize their offerings to the corresponding specialized marketplace platform	Support economic potential specialization	
16	The ability of the rural platform to integrate with 3rd party marketplace platform	Enable efficient IT Service provision through collaboration with 3rd party service provider	3
17	The ability of the rural platform to integrate with 3rd party funding platform		
18	The ability of the rural platform to integrate with 3rd party tourism platform		

In the TOE framework, Technological Context relates to the relevant technologies for the organization (Baker, 2011). Architectural requirements that are related to this Technological Context will be grouped together as Group 1. Group 2 indicates architectural requirements that are related to the Organizational Context, which is referring to the characteristics and resources of a specific firm. Meanwhile, the Environmental Context that represents the structure of the industry including the presence of technology service providers is grouped together as Group 3. In relevance with facilitating the service-oriented business collaboration platform, in this viewpoint, their inherent concerns are being grouped into technology, organization, and environment contexts represented as Figure 8 below.

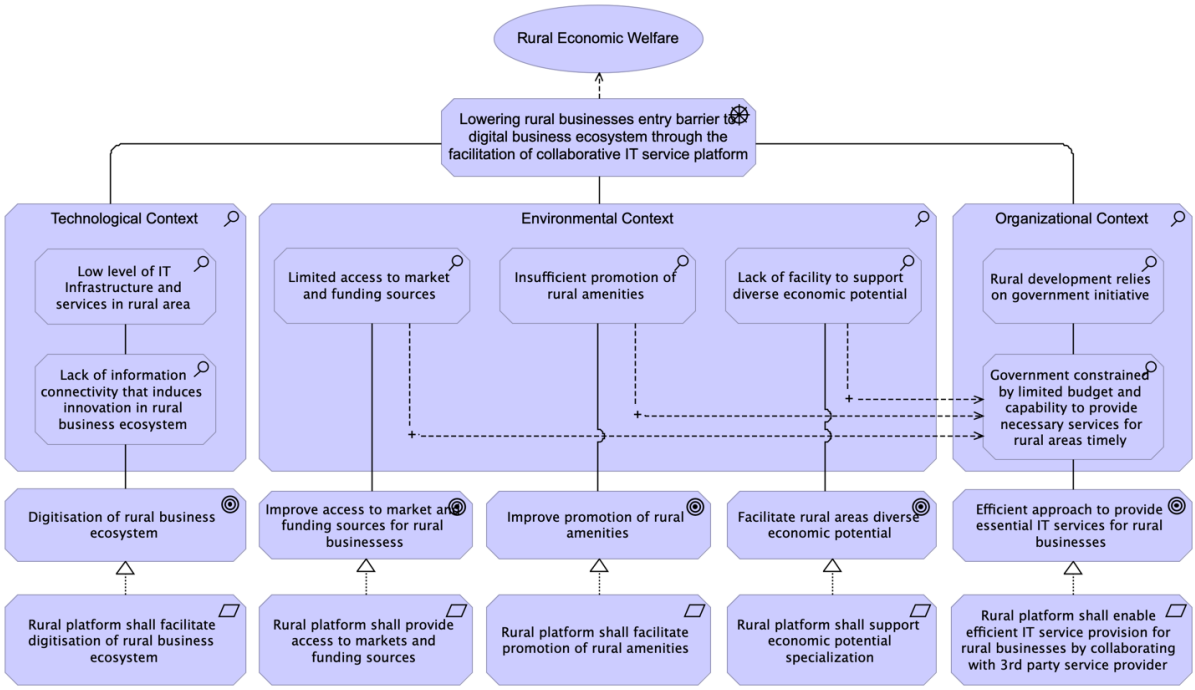

Figure 8 Rural Business Collaboration Motivation Viewpoint

This motivation viewpoint encompasses the motivation of provisioning the service-oriented rural business collaboration IT service platform, which is being motivated by the driver of lowering the entry barrier of rural businesses to the digital business ecosystem in order to achieve rural economic welfare. Following the TOE framework, the technological context focuses on the issue of low provision of collaboration supporting information technologies that cause the reduced degree of information connectivity between rural businesses with potential partners (Lusch & Nambisan, 2015; Parikh et al., 2015). The environmental context suggests that the government should pay attention to the identified demand from the rural businesses' to gain access to promote their offerings to marketplaces, funding sources to support rural businesses operations, the promotion of tourism in the rural region through collaborative IT service platform and the development of the regions' potential specialization (Cunha et al., 2020; Naldi et al., 2015; Sari et al., 2018; Schaffers et al., 2016). Meanwhile, the organizational context identifies that the government entity is under a constrain that limits their budget expenditure on IT services and infrastructure due to the existence of other pressing matters (Talbot, 2016). Hence, the need to collaborate with 3rd party service providers are surfaced.

Business Roles Cooperation Viewpoint

As discussed earlier in section 3.2, this reference architecture is intended to be applied to *multiple organizations* that share a common goal in establishing and enriching an SOA-based rural business collaboration platform with collaborative business functions, which may take the form of governmental agencies, 3rd party enterprises, and rural business entities. In this case, an architectural viewpoint to communicate the collaboration interaction between each other that follows the design principle of SOA is required. Chunquan and Dejian (2006) have illustrated a simple business roles interactions model involved in a Service-Oriented Architecture. This interactions model represented in Figure 10 comprises of stakeholders

taking the role of Service Provider that provides their resource and capability as a service to the collaboration network, Service Requestor that refers to the organization who is seeking and requesting the services provided by the provider and Service Registry that supports business processes coordination and multi-enterprise applications interoperability.

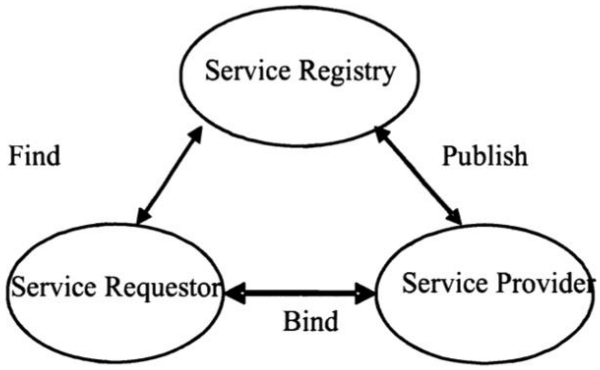

Figure 9 Business Roles in Service-Oriented Architecture (Chunquan & Dejian, 2006)

This viewpoint, known as Business Roles Cooperation Viewpoint in ArchiMate taken from The Open Group (2012-2013), focuses on the relationships of business roles with each other and their environment. As represented in Figure 11 below, the Service Registry represented as Business Role is given the name Service Broker who supports the service orchestrations and interoperability between application components owned by Service Requestor and Service Provider. The Service Provider is represented as a Business Role that exposes their resources and specialized capability as a Business Service. As described earlier, this Service Provider role may be assumed by the 3rd party enterprises who have the capability in provisioning services through their IT resources. Further, is the Service Requestor in SOA that has the role of realizing the Business Services that can be realized and provisioned internally without the shared capability from the network. This Internal Service, however, together with the Specialized Service and Service Orchestration realized by the Service Provider and Service Broker, aggregates the Rural Business Collaboration Services that aims to serve the business development of the rural business community.

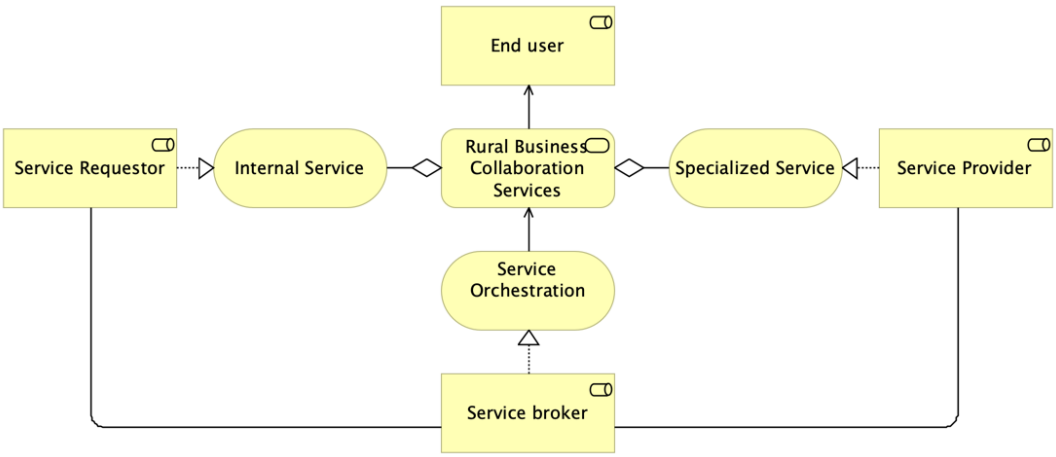

Figure 10 SOA-Based Platform Business Roles Cooperation Viewpoint

Business Services Cooperation Viewpoint

In an association with the Architecture Requirements stated earlier in the motivation viewpoint, the higher level Business Roles Cooperation Viewpoint shown above should be further elaborated into a more detailed viewpoint. This viewpoint, as shown in Figure 12, depicts the relationships of one or more architectural construct with their environment in realizing the Business Services that are working together to perform collective and collaborative behavior. In conjunction with the earlier viewpoint in Figure 10, this viewpoint further adds details towards who maintains which Application Components, which Application Component realizes which Business Functions that comprises exposed Business Service and who are to be the End Users of this rural business collaboration initiative.

The first notable extension from the previous view is that the provision of Rural Business Platform as an Application Component by a certain platform provider. This is in line with what An et al. (2012) have proposed in their case study of procurement coordination in a supply chain, stating the necessity of a business collaboration platform as a unified control mechanism for Production and Procurement. The actor of Rural Platform Provider can also be assumed to be embodied by the Government Entity since they will have the budget and authority to oversee the provisioning of this collaboration initiative (Sari et al., 2018). This platform will also be the primary Application Component to present the user interface required by the End Users to run the rural business collaboration operations.

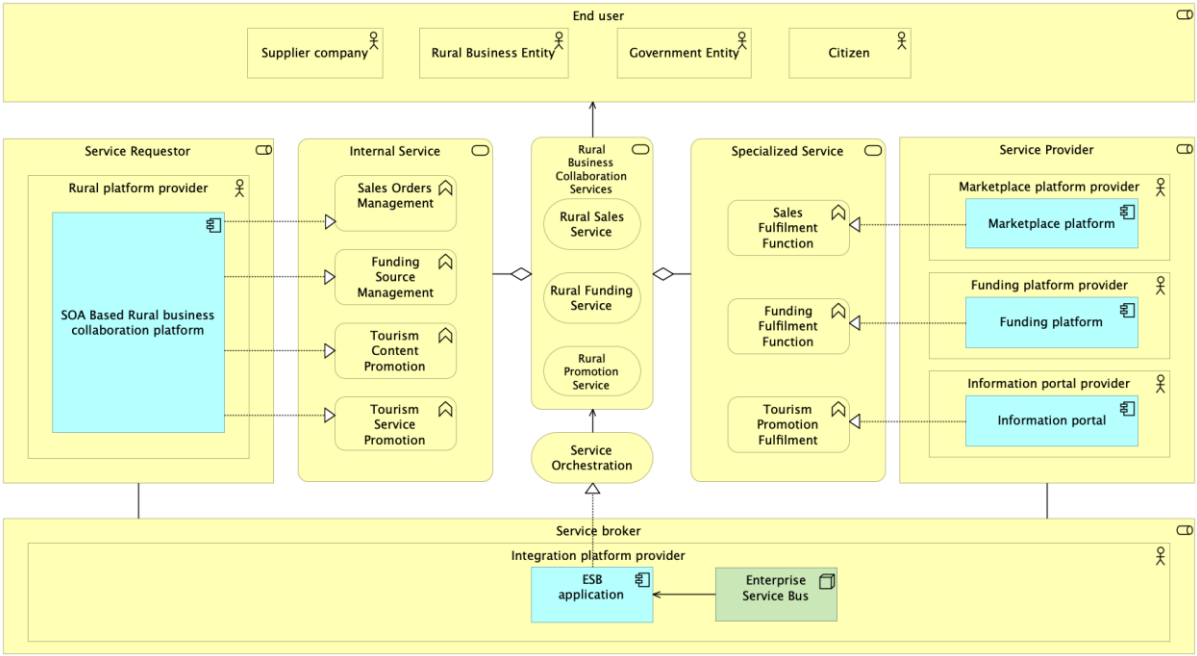

Figure 11 SOA-Based Platform Business Services Cooperation Viewpoint

This Rural Business Collaboration Platform is expected to support a set of several basic Business Functions that realize the Internal Service. One of the Internal Services is to provide the means for the Rural Business Entity to register their products and services to the platform. This is naturally required for the Rural Business Entity in order for them to expose their capabilities and collaborate with other stakeholders in the platform. This also enables them to support and collaborate with peer Rural Business Entities in realizing the function of procurement for each other. The Rural Business Collaboration Platform should also provide

the means for the Rural Business Entity to apply for funding supports and register the Tourism Potentials in their local rural region.

In the attempt to further increase the capability of these provided Internal Services, an orchestration with Specialized Services provided by the external Service Providers is required. In regards to the realization of the Specialized Services, this viewpoint further extends the previous viewpoint by envisioning the provision of Rural Sales Service, Rural Funding Service, and Rural Promotion Service. These Specialized Services are offered by the Service Providers who own and maintain specialized Application Component operating in the corresponding industry. These services are exposed to the network that may hold a certain set of business processes to function. In order to orchestrate all of these services to be encapsulated as a unified Rural Business Collaboration Service for the end-users to benefit, a Service Orchestration realized by ESB Application provided by Enterprise Service Bus technology is required. Bhadoria et al. (2017) described the ESB Application to contain a Service Stack that has a set of application services facilitating coordination between multiple services, replication and transformation of information from different data sources, and message routing from Service Requestor to Service Provider.

Through this orchestration, the Rural Business Platform can be further enriched with the Specialized Business Services. Some scenarios can be derived from this realization. Rural Sales Service provides the means for the Rural Business Entity to register their local products or services to the Marketplace Platform. Rural Promotion Service enables the Government Entity to promote local potentials by exchanging information regarding local tourism, production, cuisine, heritage, and traditions to an external tourism or trip advising platform. Rural Funding Service also makes it possible for the Rural Business Entity to request funding in regards to their business operations and development. Another augmented benefits of adopting the collaboration initiative depicted in this viewpoint is the surfaced possibility to share data among stakeholders, either Service Providers or End Users. As an example of this prospect, is the possibility for the Funding Platform Provider to gain visibility on the Rural Business Entity's business performance. This information is essential for this particular provider to discover since it will help them to determine the credit score and funding risk of the Rural Business Entity and for the potential lender or investor to assess if the business requesting the funding is appealing or not.

Due to the tendency of this business collaboration initiative to shift into a sensitive data-sharing network, the management of the said ESB as a service orchestrator should be handled and governed by an independent or separate work organization, regardless of the parent organization from which it is originated. This is suggested in order to impose a higher degree of legal formalization, refined inter-organizational alliances stability, legalized conflict resolution, and the improved prospect of shared goal consensus achievement. According to Provan and Kenis (2008), this collaboration initiative can be governed by a lead organization, an organization constituted from the representatives of the participants, or by a separate administrative entity originated externally from the collaboration network. Hence, the presence of the Integration Platform Provider in this viewpoint.

Sales Applications Usage Viewpoint

In order to further describe the previous viewpoint, the application usage viewpoints are presented from this point onward. This type of viewpoint focuses on how the applications should expose application services and communicate with each other through service

orchestration facilitated by the ESB as the integration platform to support one or more business behavior relative to the involved business roles. The reference architecture viewpoints presented in the following tend to be process-agnostic, meaning that these viewpoints try to keep the perspective as general as possible following the architecture requirements defined in Table 11 and ignores the detailed information regarding processes or other sequential activities. This is due to business processes usually differ between multiple implementation cases and highly dependent on the established business rules in the real world. Hence, the business processes implementation in the following parts is being left out to the instantiation later in the concrete architecture and aggregated as a business function instead.

Figure 13 below shows the communication between applications in the service-oriented sales orders management business collaboration initiative for Rural Business Entity. In this scenario of collaboration with the Marketplace Platform Provider(s), the previously identified Rural Business Entity as the end-user is taking the role of Seller while the Buyer may come from the business actor of Citizen. Initially, the role of (Rural) Seller is being given the ability to register their offerings to the E-Commerce module of Rural Business Platform. Through the ESB facilitated data integration and service orchestration between this platform and the partnered Marketplace Platform, their user data and registered products can be forwarded and offered in a bigger market audience with faster-paced market traffic. Next, through this mode, the Buyers may be able to discover the local rural products either from the Marketplace Platform or from the Rural Business Platform itself. The order settlement and payment can also be handled by the Marketplace Platform since they should have these capabilities in place already. Meanwhile, the orders will be forwarded back from the Marketplace Platform so that the Rural Business Entity can manage and handle the incoming orders through the Rural Business Platform. This way, the E-Commerce module offered in the Rural Business Platform does not need to compete with the industry-leading Marketplace Platform and instead, enriches each other with market access and market penetration.

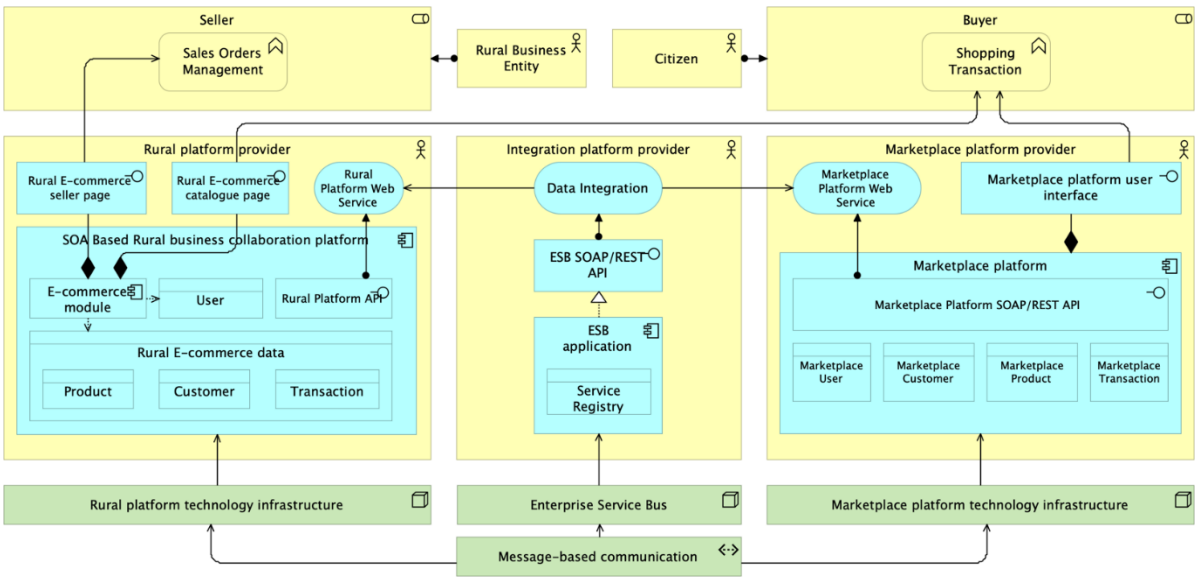

Figure 12 SOA-Based Platform Sales Applications Usage Viewpoint

In terms of the inter-organization application components integration, multiple constructs can be identified. As mentioned earlier, User data of the Rural Business Entity as

the End User of the Rural Business Platform is expected to be forwarded and synchronized with the Marketplace Platform. This is to minimize the additional effort for the Rural Business Entity to manage their user or business profile account, especially when multiple Marketplace Platform(s) are participating in the network. Next, data to be integrated with Marketplace Platforms are data regarding the Rural E-Commerce itself that may consist of information of registered Products, incoming Transactions (Orders), and the Customer (Buyer). Due to the possibility of having different data formats, structures, API calls method, and integration patterns, these integrations should be facilitated by ESB Application that is made possible to perform message mediations such as message transformation or routing. In order to integrate the mentioned data and perform the orchestration, the ESB, along with the Rural Business Platform and Marketplace Platform(s) are expected to set up APIs and publish the Web Service. These APIs may be exposed using SOAP protocol with XML as the message format, or lately, REST protocol with the JSON message format resembling the earlier pair has also been widely used in the industry (Bhadoria et al., 2017).

Funding Applications Usage Viewpoint

As indicated in earlier Table 11 and Figure 12, the provision of funding source management to this rural business collaboration initiative is to be expected. Similar to the previous viewpoint, the viewpoint presented in this subsection tends to be process-agnostic and focuses on the communication between applications in the service-oriented funding source management business collaboration initiative for Rural Business Entity. In this collaboration scenario with the Funding Platform Provider, Rural Business Entity will take the role of Borrower and the role of Lender may be assumed by either the Government or the Citizen. Government agencies and citizens are encouraged to provide funding support to the rural businesses in order to further contribute towards public-private-community participation and connectivity. Funding provided by the Government agencies can be facilitated directly by the same Rural Business Platform since there is a probability that the Government is also the major sponsor of the provision of this platform. In this case, the government may get more direct control towards the funding process for the Rural Business Entity, but at the expense of a more extensive budget allocation to develop and maintain a dedicated application module for this specific requirement. On the other hand, the funding model for citizen participation may take the form of crowdlending (P2P Lending) or crowdfunding initiative facilitated by Funding Platform(s) and provided by Funding Platform Provider. Through this approach, the Rural Business Platform is only required to prepare a sufficiently robust interface for the Rural Business Entity to apply for and manage fundings, and then the mechanism to raise the funds will take place in the partnered Funding Platform. Thus, realizing one of the goals of SOA adoption is to lower the total cost of development and ownership of the Rural Business Platform for the Rural Platform Provider.

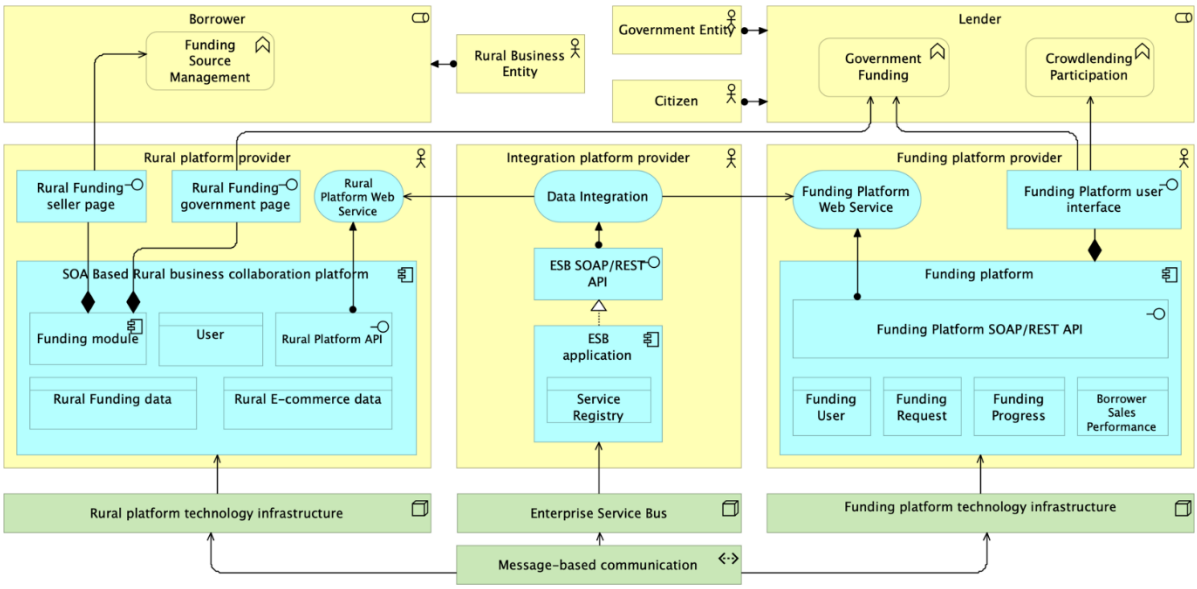

Figure 13 SOA-Based Platform Funding Applications Usage Viewpoint

Communication between applications takes a rather similar approach as the previous scenario of sales orders management business collaboration, where the Rural platform provider provide the Funding Module in the Rural Business Platform that stores and manage data regarding funding request of the Rural Business Entity. This funding request data are to be forwarded and integrated with the partnered specialized Funding Platform, where the actual crowdfunding process will be issued and settled. Similarly, the data integration and service orchestration are also facilitated by the ESB application. Furthermore, as mentioned in the Business Services Cooperation Viewpoint earlier regarding the prospect of this funding source management initiative, this collaborative Rural Business Platform also makes it possible to share the sales performance of the rural businesses to the other Service Provider. This is because the platform has established integration with the Marketplace Platform and the sales transaction data is stored and managed in the same platform. By sharing the sales transaction data to the Funding Platform, the Funding Request data can be enriched with useful information such as credit score and funding risk assessment to attract potential lenders.

Tourism Applications Usage Viewpoint

Integration of data regarding tourism information is a valuable asset in bringing competitive advantage to the community, especially to the economic development of the rural community. Banek et al. (2008) have suggested that the tourism portal may gather data from business entities offering tourism services and products, tourists as the customer, and also local government. Based on these suggestions, the Rural Business Entity, who offers their products and services related to tourism, is being identified as the Tourism Agency in this collaboration scenario with the Tourism Platform. The Government Entity is being identified as the Tourism Content Manager who are entitled to manage the promotion of tourism contents and services. Citizens, as the Tourists, will have the access to obtain information and services regarding local rural tourism offerings through either the Tourism Catalogue in the Rural Business Platform or through a 3rd party Tourism Platform that has partnered with this collaboration initiative. The benefit that may be realized through this collaboration is that the

Government Entity and Rural Business Entity will gain broader exposure and market access, while the Tourism Platform Provider as the partner may gain complementary tourism contents and services from the local business owners. In turn, is extending the range of products and services that they can offer to their customers (Cunha et al., 2020).

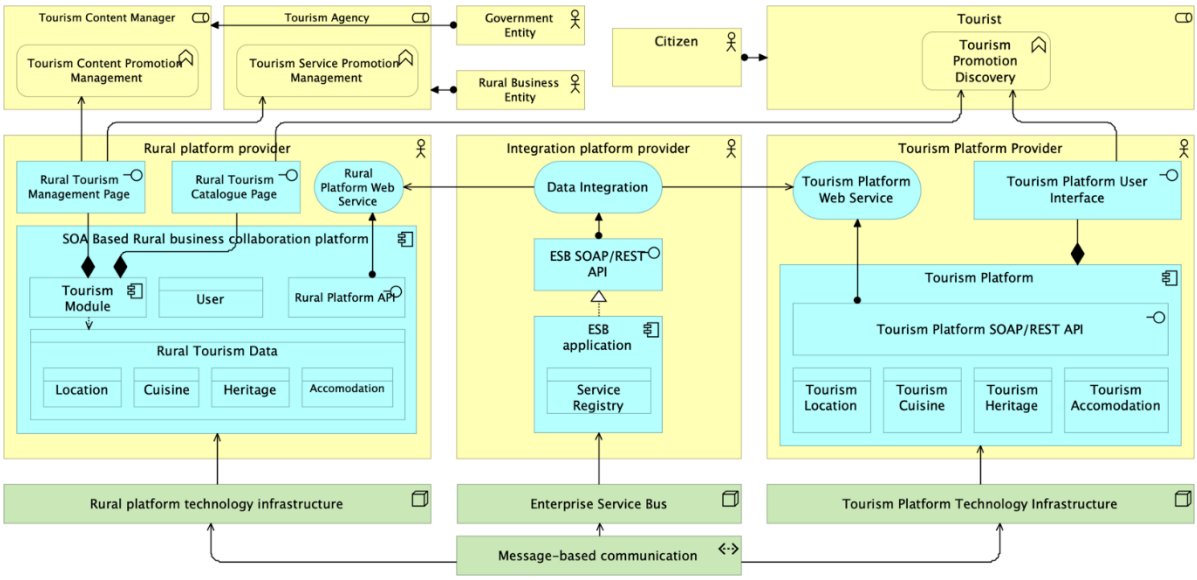

Figure 14 SOA-Based Platform Tourism Applications Usage Viewpoint

Communication between applications follows the same pattern as the previous business collaboration scenarios, where the Rural platform provider provides the Tourism Module in the Rural Business Platform that catalogs and manages data regarding local tourism offerings such as local tourism places, cuisine, historical heritages, and accommodations. These data are to be published and shared with the partner Tourism Platform Provider to extend the market access and complements the offerings in the Tourism Platform for their customers. Data integration and service orchestration are also facilitated by an ESB application, allowing services interoperability with external processes, which is regarded as a prerequisite for a smart region (Cunha et al., 2020). This section concludes the Architecture Design Synthesis step of the Reference Architecture Design Framework by Angelov et al. (2012) and Nakagawa et al. (2014). The next step is to evaluate the reference architecture in a specific case study, which will be discussed in the next chapter.

4. Instantiation of SOBC Platform for Rural Business Ecosystem Concrete Architecture

Based on the proposed reference architecture in the previous chapter, this chapter demonstrates the instantiation of the concrete architecture of an SOBC platform for rural business ecosystems. This instantiation is carried out by implementing the reference architecture into a specific case study, particularly in the West Java Digital Service initiative in West Java Province, Indonesia. Furthermore, in order to demonstrate the operationalization of the reference architecture, a working prototype adhering to the instantiated concrete architecture was also developed in this process. This working prototype will then represent the proposed architecture to be validated and evaluated by the stakeholders in the case study.

4.1. West Java Digital Province Initiative

West Java, by having more than 48 million people living in 27 cities and 5,312 villages, is being recorded as the most populated province in Indonesia (BPS, 2018). With around 70% of the population in the province living in urban areas, it is aligning towards the global trend of urbanization (Widiawaty, 2019). Despite this, statistical data also shows that the classification of rural/districts according to income in West Java is dominated by agricultural activities for over 75%, followed by the manufacturing industry and services (Sari et al., 2018). According to the Indonesian Central Bureau of Statistics, this province has a higher economic growth rate of 5.58% as compared to the national economic growth of 5.17% (BPS, 2018). On the other hand, this region also has a higher wealth inequality index (Gini ratio) and the unemployment rate of 0.405 and 8.17% respectively, compared to the national average of 0.398 and 5.34%. Given this backdrop, this situation suggests that there is a large economic inequality distribution in the region caused by the concentration of economic power in a few urban areas.

In response to this situation, the government of West Java province introduced the West Java Digital Province initiative to improve the economic welfare of all citizens in the region. One of the major programs in this initiative is the digital village program. The objectives of the program are to provide the villages within the region with access to technology infrastructure and services, education for digital literacy, and access to the capital market. Among all of the villages in the province, currently, there are 500 digital villages involved in this program. As this governmental “smart village” innovation program has been recently initiated and several business partners have stated their interest to participate, the regional government is currently working on the definition of a clear vision on how this program should be carried out.

Based on this phenomenon, there is a necessity to research how to improve the economic welfare of the people living in the rural areas through the concept of rural smartness. One of the hypotheses is to develop and implement a service platform that fosters partnership and collaboration between public-private sectors (Mukti, 2019; Mukti et al., 2020). In line with this research initiative, the reference architecture developed in this paper is to serve as a reference to instantiate a concrete architecture to be applied in the context of the West Java Digital Village Program. The instantiated concrete architecture is then to be

used as a guideline to develop a working prototype of the rural business collaboration service platform.

4.2. Concrete Architecture Instantiation

As explained by Angelov et al. (2012), concrete architecture is the architecture designed and used for the development of a system in a specific application. In this section, the design of the concrete architecture is being done by referring to the reference architecture proposed in the previous chapter and further customized to align with the circumstances of the selected case study. The concrete architectures presented below are focusing on the application usage viewpoints, which highlight the business processes and services orchestration of the rural service platform with 3rd party marketplace, funding, and tourism promotion platforms. This decision to focus on the selected viewpoints is also taken in order to emphasize the aspect of service-oriented business collaboration defined in section 1.4.1 earlier.

User Account Management Application Usage Viewpoint

Prior to performing any activities of the Rural Business Entity that are supported by this Rural Business Collaboration Platform, a viewpoint that governs the user management business processes and services orchestration should be provisioned beforehand. This viewpoint presents the Account Registration function available for the Rural Business Entity in order to be a user in this service platform, but also applicable to the case when the user updates the information of their user account. This viewpoint also highlights the interaction between the Rural Business Platform with the 3rd party marketplace, funding, and tourism platform. The interaction with the Tourism Promotion Platform elaborated here is intended for the perspective of the Rural Business Entity, since the viewpoint presented in Figure 15 below focuses on the provision of user access for business entities who offer local products and services and engage in transactions in each of the corresponding platforms.

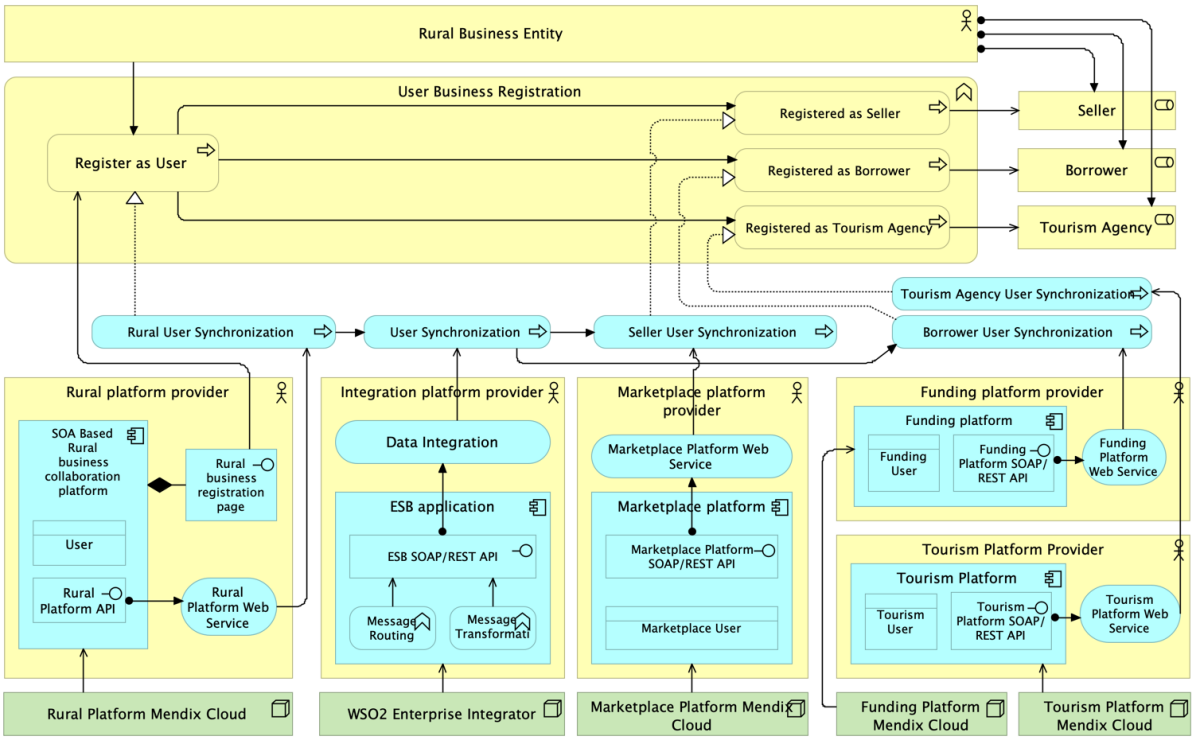

Figure 15 User Account Management Application Usage Viewpoint

The business function of User Registration is initiated when the Rural Business Entity started to perform Register as User through the Registration page in the Rural Business Collaboration Platform. This grants the Rural Business Entity as User to initiate User Synchronization process in the application side that sends the submitted User data from the Rural Platform Web Service to the User Synchronization process published by the data integration service provided by the ESB. The role of ESB is required due to the fact that the data format of the user required by the 3rd party platforms along with their API endpoints may differ from each other. In this case, ESB offers the functions to transform the relayed user data into the required format in the other platforms and route each message payload to the corresponding platform endpoints, lifting Rural Platform's burden of data format adjustment for every 3rd party platform. Following this routing process, the registration process is then performed in each of the 3rd party platforms, which finally grants Rural Business Entity the role of Seller in Marketplace Platform, Borrower in Funding Platform, and Tourism Agency.

Sales Orders Management Application Usage Viewpoint

This viewpoint provides the visibility towards the interaction between Rural Business Collaboration Platform and the Marketplace Platform in providing the Sales Orders Management function for the Rural Business Entity. The previously process agnostic business function of Sales Order Management in the reference architecture is now further detailed by specifying business processes in the viewpoint of Figure 16 below. The process is initiated with the Rural Business Entity register their products to the Rural Platform. This makes it possible for the Citizens to discover and buy their products. However, registering the products in this platform alone will not necessarily grant Rural Business Entities the desired market access, since this platform will be new in the market and the traffic of the visitor can be low.

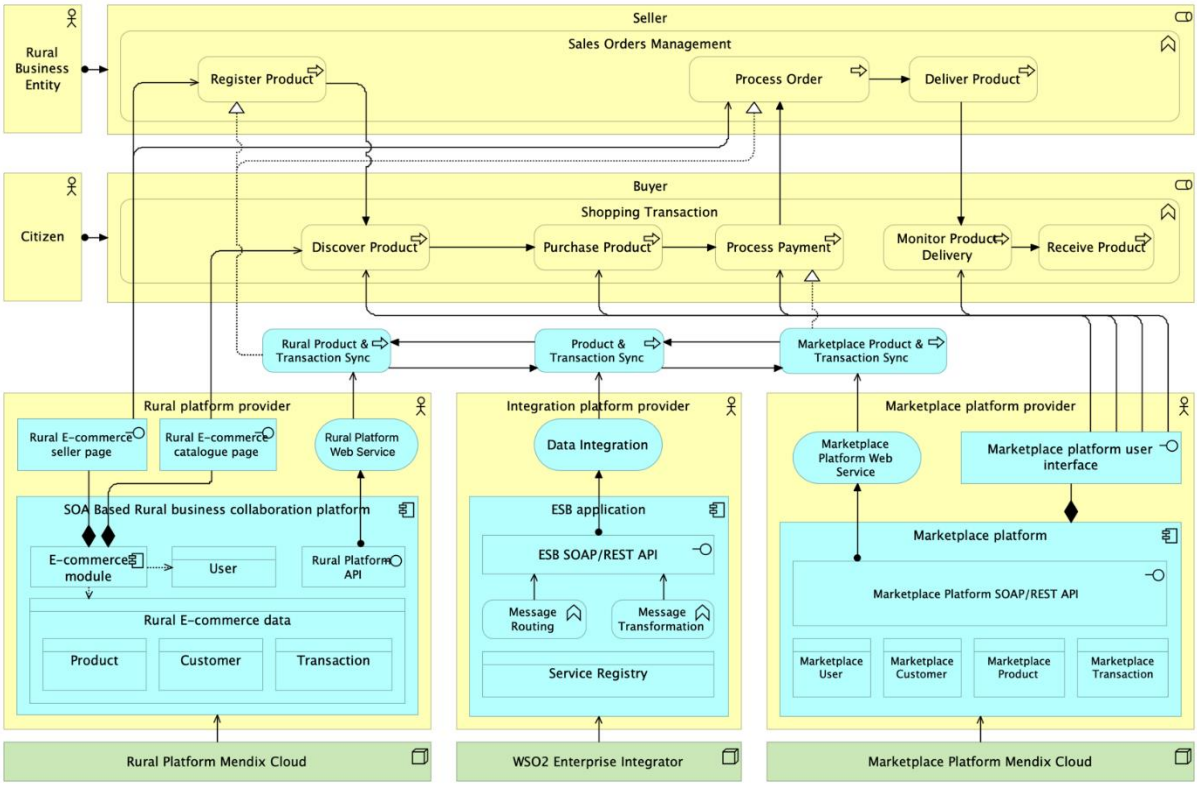

Figure 16 Sales Orders Management Application Usage Viewpoint

In response to this limitation of market access, this initiative aims to publish the registered products to the partnered 3rd party Marketplace Platform. This is performed by the process in the application side where the products are being synchronized to the Marketplace Platform through the service provided by the ESB. The reason for the need for ESB still retains from the earlier viewpoint, while in this case, the Marketplace Platform side has the potential to consist of multiple e-marketplaces from a different company that also requires dissimilar data formats and endpoints. This product synchronization also enables centralized management of Rural Business Entities' product offerings in the partnered sales channel, which helps to lessen Rural Business Entities' effort of redundant tasks.

Subsequent to this product synchronization that made the products discoverable either in Rural Platform or in Marketplace, Buyers are now able to purchase the product and settle the payment for their transaction. Due to the synchronization, the transaction can now be performed on the Marketplace Platform side and the transaction data will be relayed to the Rural Platform for the Rural Business Entity to process and fulfill. Updates of the transaction data such as the transaction status and delivery number for package tracking can be synchronized to the Marketplace Platform, enabling the buyer to monitor the delivery status from the Marketplace Platform. This synchronization ability also facilitates the Rural Platform the means of transaction processing without requiring the platform to provide the full capability of transaction processing and payment settlement. However, in the application prototype development of this initiative in this research, the payment settlement process will be simplified rather than a complete simulation.

Funding Source Management Applications Usage Viewpoints

This viewpoint identifies the interaction between the Rural Business Collaboration Platform and the Funding Platform in providing the Funding Source Management function for the Rural Business Entity. The previously abstracted business function is further elaborated by adding business processes as shown in Figure 17 below. Rural Business Entity as the Borrower in this scheme, the first step in funding sourcing is to first apply for funding in the Rural Platform. Through this initiation, the registered funding application is then being forwarded and synchronized to the partnered 3rd party provided Funding Platform. This enables the forwarded funding application to be discovered by the public Citizens who acted as the Lender and used to interact with the Funding Platform to look for a potential investment opportunity. The participation from the Government Entity in providing funding to the Rural Business Entities is not presented in this scheme, indicating that citizen participation is being emphasized in this particular case. Moreover, due to this synchronization initiative with the 3rd party Marketplace earlier, the Funding Platform can now request the Rural Business Entities transactions and product catalogs data from the Rural Platform. This additional information can be used by the Funding Platform to generate a report and assess the Rural Business Entities' business potential and performance, providing enhanced insight for the potential investors.

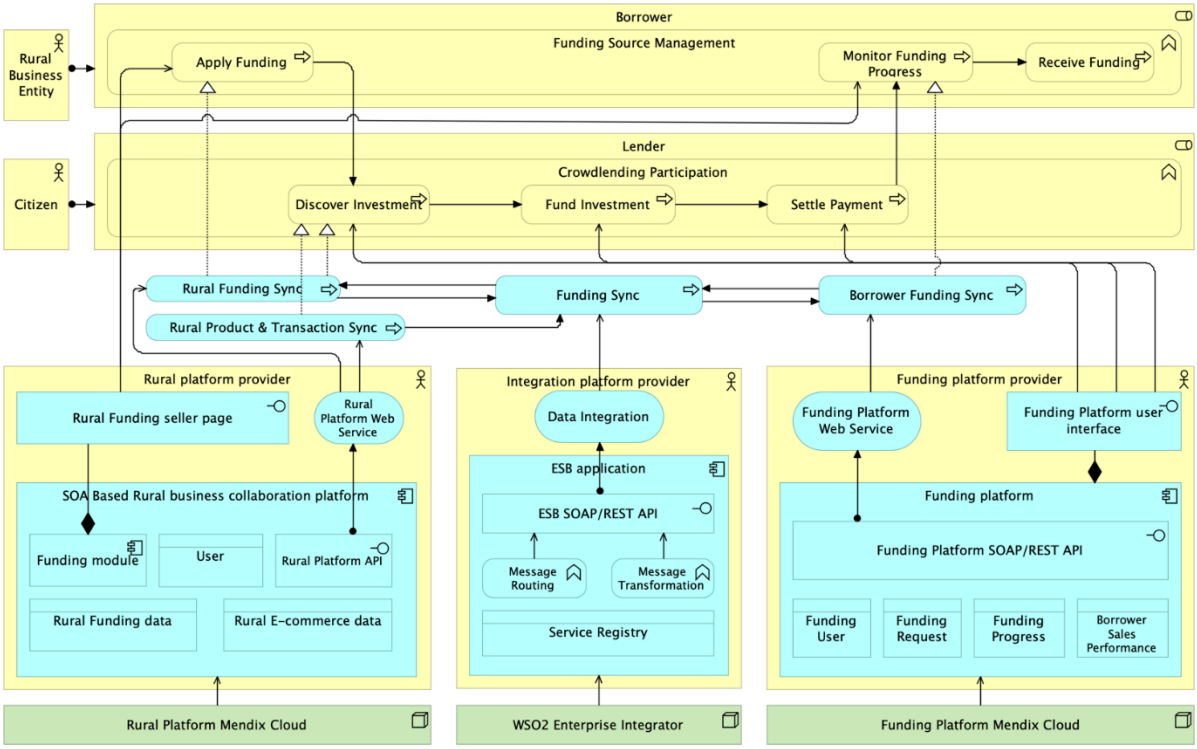

Figure 17 Funding Source Management Applications Usage Viewpoint

Further, the Lenders may proceed to fund and settle the payment for the selected investment. This enables the fund to be accumulated in the Funding Platform side, in which, through this synchronization scheme, each particular funding application data can be requested its progress detail by the Rural Business Entity from the Rural Platform side for centralized monitoring and control. Finally, when the amount of accumulated fund has achieved its requested amount, then the Rural Business Entities are assumed to have received their funding. Similar to the business function in the previous viewpoint, in the application

prototype development later, the payment settlement process will be represented as a simplified version.

Tourism Content Promotion Management Applications Usage Viewpoints

This viewpoint administers the interaction between the Rural Business Collaboration Platform and the Tourism Platform in provisioning the business function of Tourism Content Promotion Management. In the case of West Java Digital Province, the initial focus of tourism promotion concerns the information publishing of the region‘s tourism potential. The viewpoint of this initiative is being represented in Figure 18 below. Through this collaboration initiative, the Government Entity takes the role of the Tourism Content Manager who registers, manages, and publishes the region’s potential tourism information. In this case, the publishing process is fairly simple, which the Tourism Content Manager can publish the content to the Rural Platform to enrich the information being shown on the platform.

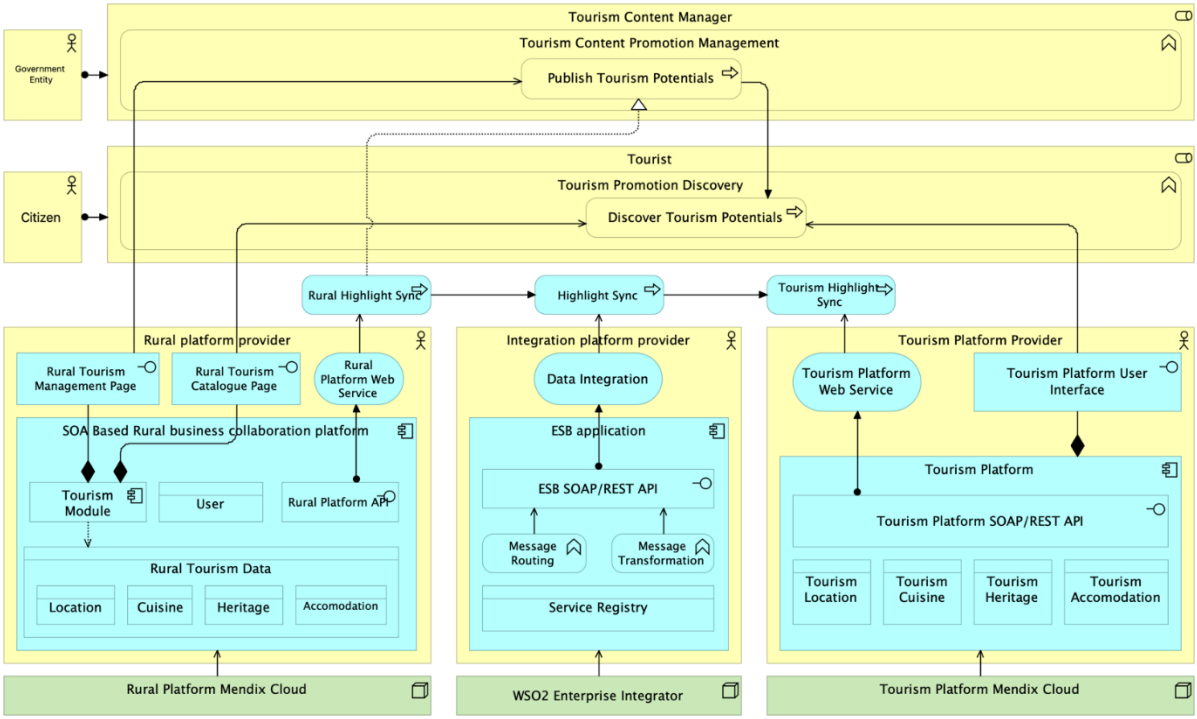

Figure 18 Tourism Content Promotion Management Applications Usage Viewpoints

Moreover, the same information can also be forwarded and published to a partnered Tourist Platform to further extend their tourism contents and promotion. In this tourism information publishing collaboration with the 3rd party provider, the Rural Platform acts as the information feeds publisher for the Tourism Platform. This information can be used by the Tourism Platform to offer a tour and travel package for their customers who act as the Tourist. Similar to the previous viewpoints, the information forwarding is also enabled by ESB, facilitating the means of integration in case of diverse required data format and endpoints.

Tourism Service Promotion Management Applications Usage Viewpoints

Through the previous tourism content promotion that enables the discovery of tourism potentials, this additional viewpoint is presented in order to further exploit the opportunity

to promote rural tourism services. This scenario is also proposed to cohere with the rural specialization previously suggested by Naldi et al. (2015) in supporting smart rural development that takes into account the diversity of rural amenities. Due to the published information earlier promoting tourism potentials of tourism specialized rural region, tourism services of that region can finally be made relevant with the local rural amenities and offered to the customers to extend the value proposition of that rural region. Figure 19 below presents the viewpoint being discussed in this section.

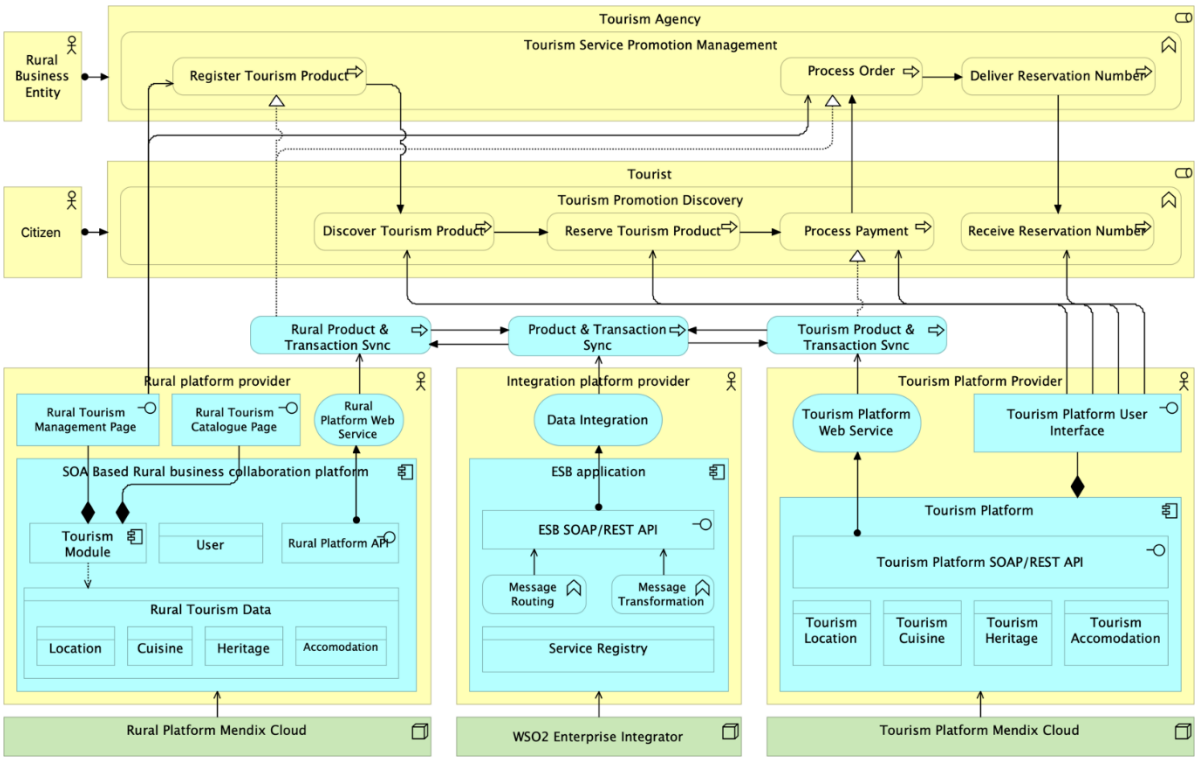

Figure 19 Tourism Service Promotion Management Application Usage Viewpoints

This viewpoint facilitates the Rural Business Entity as the Tourism Agency, who runs and manages tourism business in a rural region, to register and promote their tourism business to this collaboration initiative. In this scheme, Tourism Agencies can register and offer tourism services such as hotels, resorts, activities, or events through the Rural Platform. Similar to the previous scenarios, their tourism services will be forwarded to an assumingly respectable Tourism Platform that has bigger market access and specialized customer profiles. Consequently, the Tourism Platform customers, or the tourists, will be able to discover the local offerings and make a reservation or booking of the tourism services. Reservation transactions and payments will then be performed on this 3rd party Tourism Platform. However, as the reservation has been paid, the order information will be forwarded back to the Rural Platform to be processed by the Tourism Agent.

4.3. Prototype Implementation of Concrete Architecture

In order to represent the proposed architecture above so that it can be validated and evaluated by the stakeholders in the West Java Digital Province Initiative, a working prototype needs to be developed. Following the proposed architecture, in this implementation scenario, multiple prototype application is developed. Due to the purpose of ease and rapid

development, all of the prototypes (except the ESB) are developed using Mendix. This development platform is regarded as one of the leading low-code solutions recognized by analyst reports such as Gartners and large enterprise companies such as SAP and IBM (Mew & Field, 2018). Mendix platform enables developers to build web applications in a complete package starting from the database model, back-end system with web services using REST API as well as the front-end user interfaces. Mendix also offers developers to publish and host their application to Mendix Cloud. This enables the possibilities of remote prototype demonstration and validation with the project stakeholders later on since the stakeholders of this West Java Digital Province Project are located in West Java province in Indonesia itself.

In order to serve as a centralized platform that supports rural business operation, the Rural Platform as the first prototype is developed. This platform is assumed to be provided and administered by the West Java Government Agency for the local Rural Business Entities, Supplier and Citizen. Based on the proposed architecture, the Rural Platform serves internal services that support Rural Business Entities with business functions of Sales Orders Management, Funding Source Management, Tourism Content Promotion, and Tourism Service Promotion. These internal services are provided for the Rural Business Entities to register their product offerings, apply for funding and promote their tourism service offerings respectively.

In respect to the collaboration aspect of this smart rural initiative, other 3rd party owned platform is provisioned. The second prototype is referring to the Marketplace Platform. In this case study, two marketplaces are developed and assumed to be provided by 3rd party marketplace providers. The first marketplace, named TokoMart, is intended to be a general B2C marketplace that provides a wide variety of products to the customers. The second marketplace, called FarmHub, is assuming the role of a specialized B2C marketplace that connects farmers and their fresh produces directly to end customers. This specialized farming products marketplace is also considered vital for this initiative due to the high-density agricultural activities identified in the West Java province. The third prototype represents the Funding Platform that provides crowdlending services for the Rural Business Entities and offering them to the public as investment opportunities. The fourth prototype refers to the Tourism Platform, which specializes in promoting tourism information and offering tourism services. Lastly, the orchestration of the services provided by these platforms is being facilitated by WSO2 Enterprise Integrator (EI), an integration platform that offers the essential features of an ESB.

User Account Management

In order to gain access to perform these business functions, the Rural Business Entities are being given the means to manage their user account, especially in respect to acquiring access to exchange information with the 3rd party platform. As described in Figure 15 earlier and demonstrated in Figure 20 below, they can choose which platform their user account will be synchronized to, which in this scenario the option will be to 2 e-marketplaces and 1 tourism platform. Figure 20 does not present the user synchronization option with the previously mentioned Funding Platform, since this study case assumes that there is only one Funding Platform partnered with Rural Platform and this user synchronization process will take place prior the Rural Business Entity apply for funding, which will be discussed later.

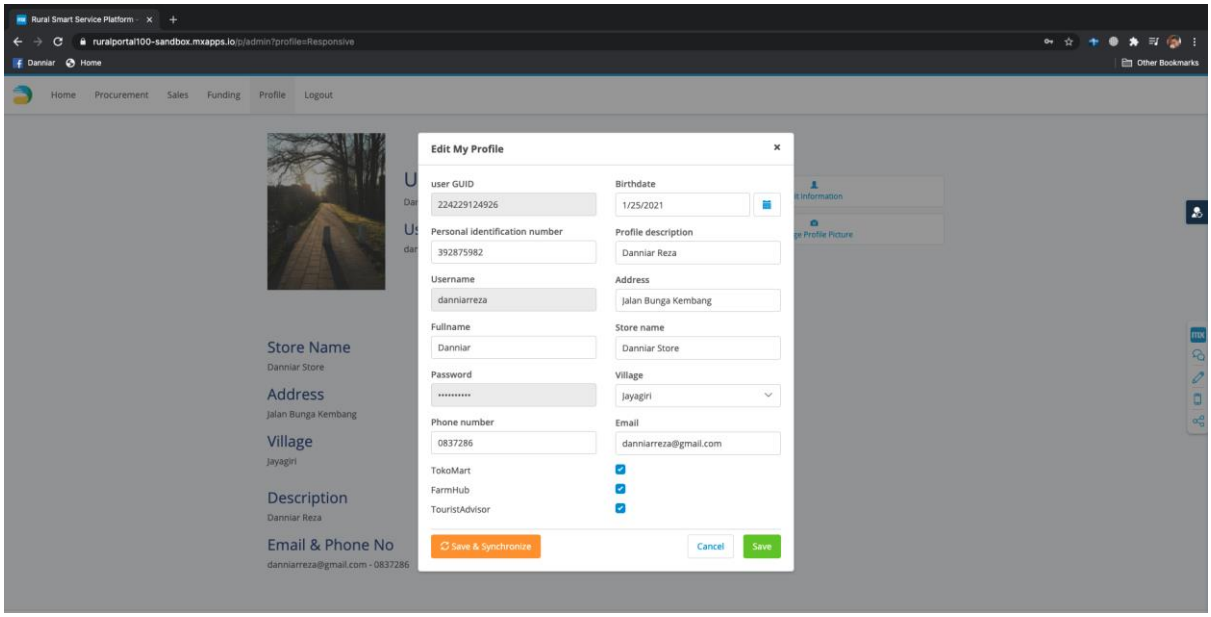

Figure 20 Rural Business Collaboration Platform User Management Page

Sales Orders Management

Following the previous User Account Management process, the Rural Business Entities as the User in the Rural Platform will now gain the access to publish their product offerings to the available and corresponding Marketplace Platform. The word 'corresponding' is used here due to the constraint placed upon which 3rd party platform that the user account has been synchronized with and the category of the product is being uploaded.

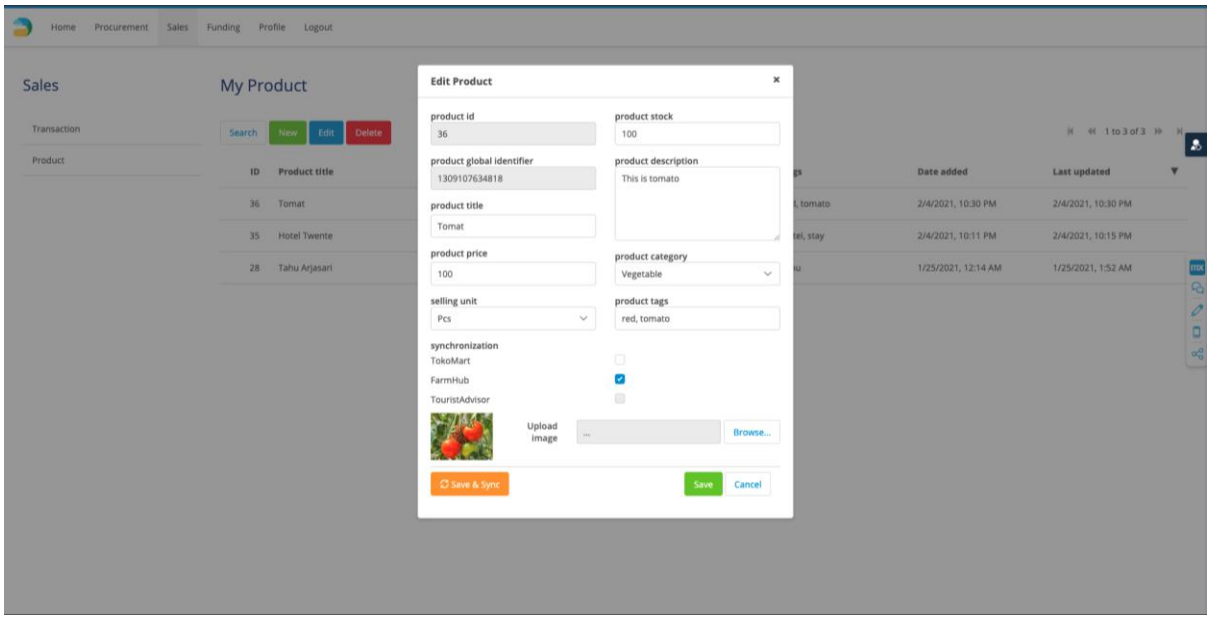

Figure 21 Rural Business Collaboration Platform E-Commerce Seller Page

For example, as demonstrated in Figure 21 above, assuming that the user has synchronized his account with all of the available 3rd party platforms as shown in Figure 20 previously, the product with the category of 'vegetable' will only be available to be synchronized with either the general e-marketplace or specialized e-marketplace in farming. On the other hand, in the case when the user has not synchronized with a particular 3rd party

platform, even if the product category is matching with that platform, then the synchronized function cannot be performed.

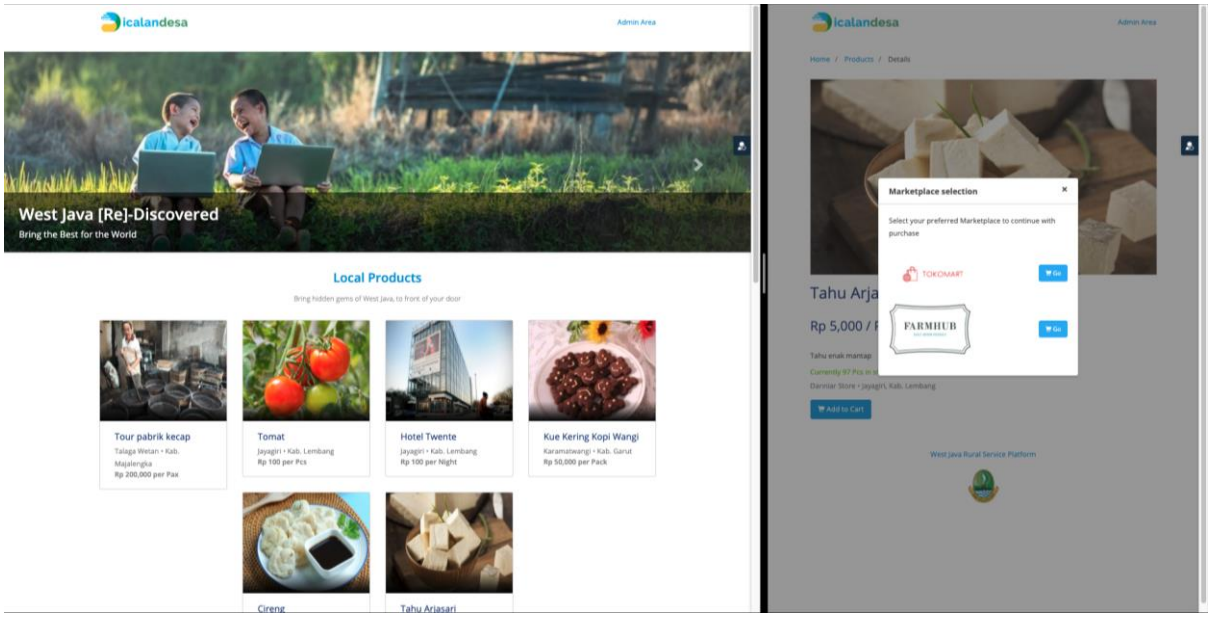

Figure 22 Rural Business Collaboration Platform E-Commerce Catalogue Page

Subsequently to this product registration, the Citizen can now discover local products of the region through the E-Commerce Catalogue page in Rural Platform. Meanwhile, it is also possible for the Citizen to discover the products in the partnered Marketplace Platform, either in TokoMart or FarmHub, as the products can be synchronized to the other platform. This enables the Citizen to perform the transaction through the partnered Marketplace Platform, where an established transaction and payment settlement capability is provided. Figure 22 above shows the E-Commerce Catalogue page where the Citizen can discover local products offered by the Rural Business Entities and where they can be offered to be redirected into the corresponding Marketplace Platform to settle the transaction.

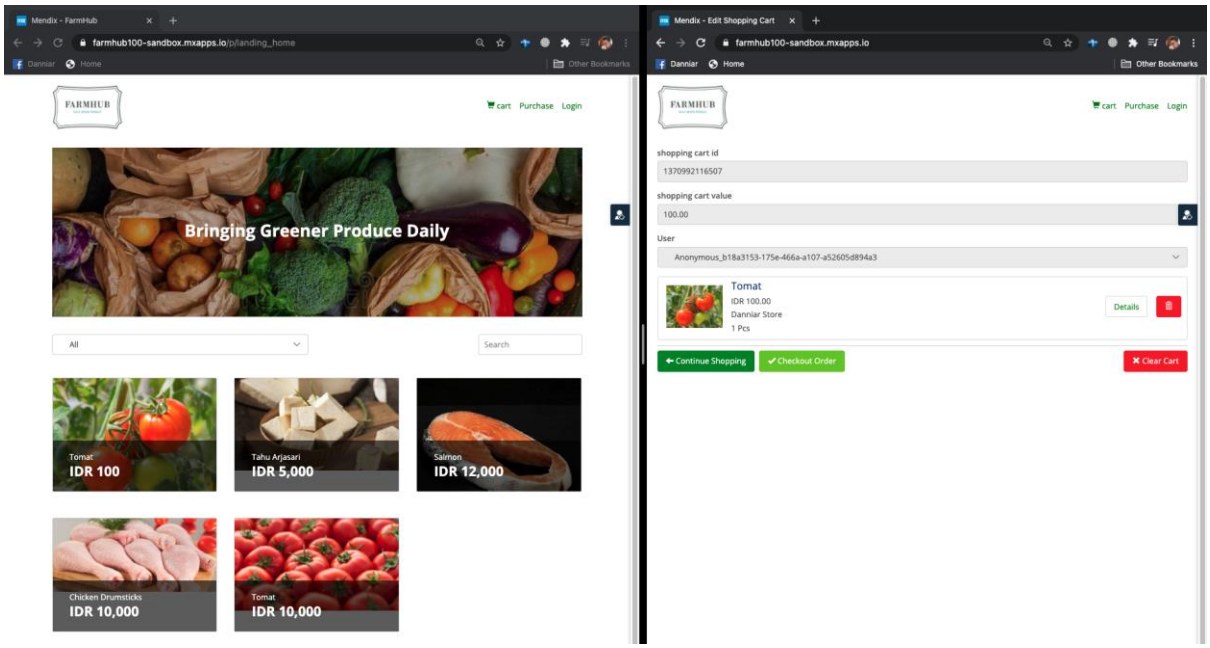

Figure 23 Product Transaction being Redirected to FarmHub

According to the proposed architecture, after the buyer settled for the payment of their purchase in one of these marketplaces as demonstrated in Figure 23, the order transaction data will be passed on to the ESB to be transformed and routed to the Rural Platform where the Rural Business Entity can process and fulfill it from a centralized platform as shown in Figure 24 below. As the Rural Platform receives the 'paid' transaction order from each of the marketplace platforms and assumed order processing, the changes in the stock amount of the product being purchased will be broadcasted to the synchronized marketplaces by the ESB through the same message routing principle, which will be discussed later. Finally, from the Buyer's perspective, they can still monitor the change of the delivery status of their order through the same platform where they settled the transaction.

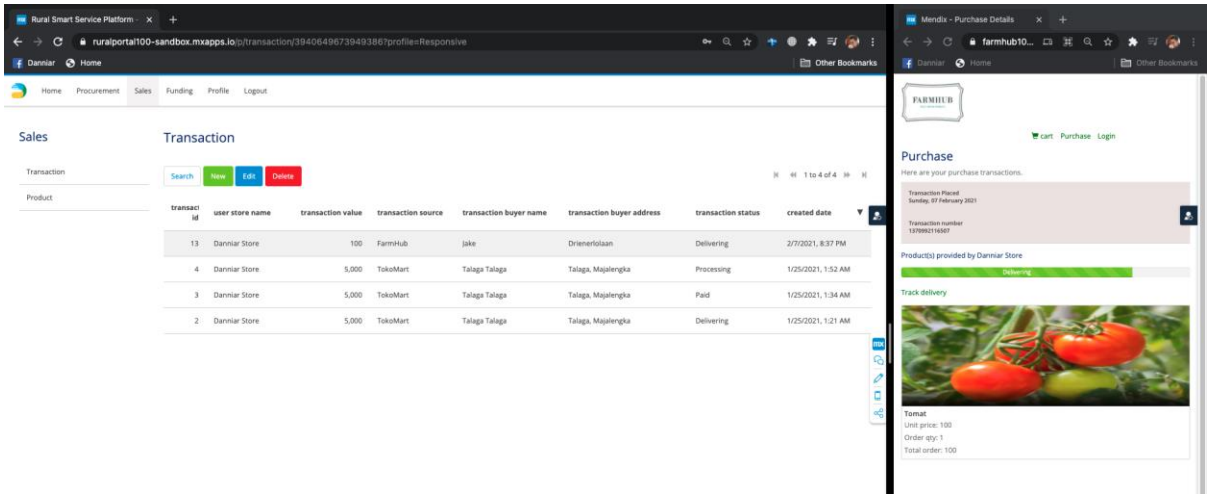

Figure 24 Rural Business Collaboration Platform Order Management Page

Funding Source Management

As suggested by the architecture as well, this Rural Platform should also facilitate the Rural Business Entities in applying for funding. In this prototype, the Rural Platform provides a page where the user can apply for funding by choosing a partnered Funding Platform (which in this case, only one option available) and filling the required information such as illustrated on the left side of Figure 25 below. The right side of the figure shows the details and progress of the submitted funding request, where information such as total current investment, the risk level of the investment, or the investment status is provided by the partnered 3rd party Funding Platform. Similar to the marketplace synchronization, this enables the Rural Business Entities to monitor and manage their funding application in a centralized platform.

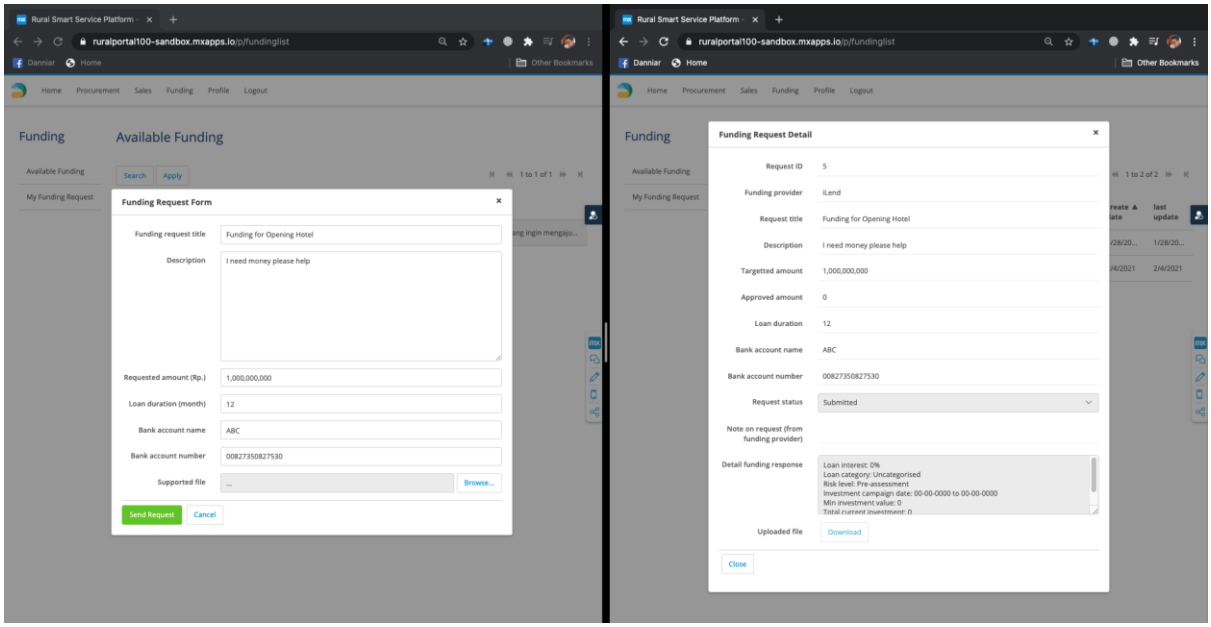

Figure 25 Rural Business Collaboration Platform Funding Request Page

After the funding application is submitted, the targeted Funding Platform, which is given the name iLend, receives the funding (loan) request that is still under the 'Pre-assessment' phase to be assessed in their back-office side. In this stage, the benefit of this collaborative initiative between the Funding Platform and Rural Platform is also instantiated in the form of business performance data sharing. Through this provision of the Borrower's sales performance from the Rural Portal, the administrator of the Funding Platform can gain better clarity and better judgment in assessing the eligibility of the applicant's funding request. The risk level of this funding request as an investment opportunity from the perspective of the potential investors can also be determined. When the administrator has approved the application and determined the appropriate interest of the funding, the investment opportunity can finally be discovered by the potential investors to be funded and fulfilled.

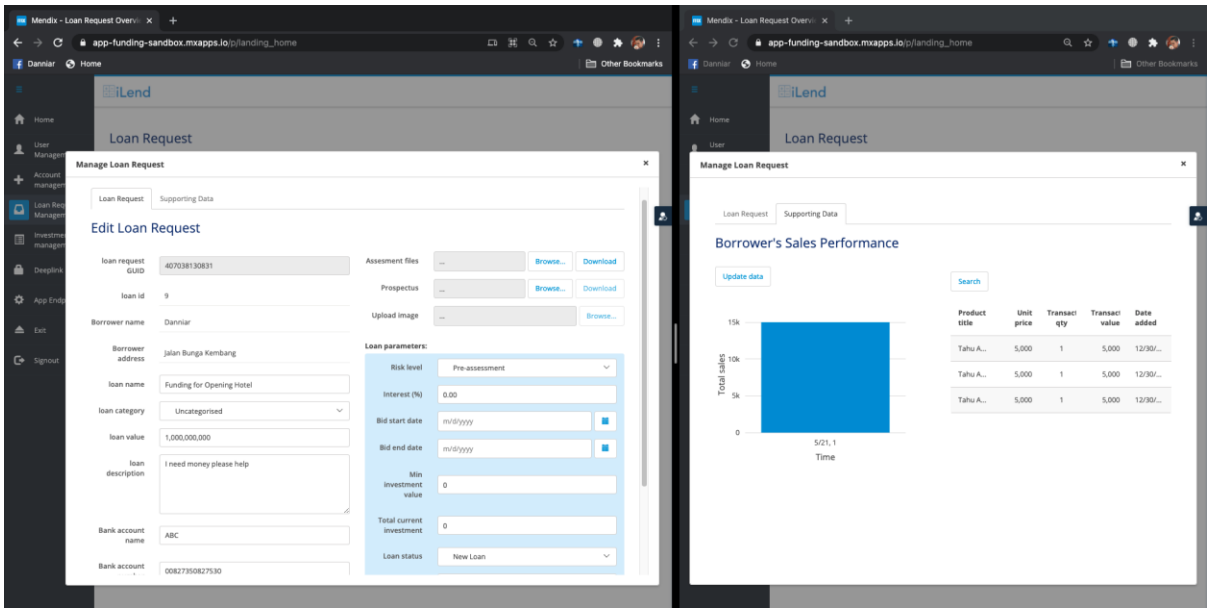

Figure 26 iLend Submitted Funding Request and Borrower's Sales Performance

Following the approval for the funding application, the request is now discoverable to the public as investment opportunities. As the previous architecture in Figure 17 suggests, the next step of this funding sourcing scenario from the Lender or Investor perspective is to fund the investment and settle the payment for the investment. In order for the Rural Business Entities to see and receive the progress of their application, Figure 27 below demonstrates how the Lender will provide financing towards the funding request.

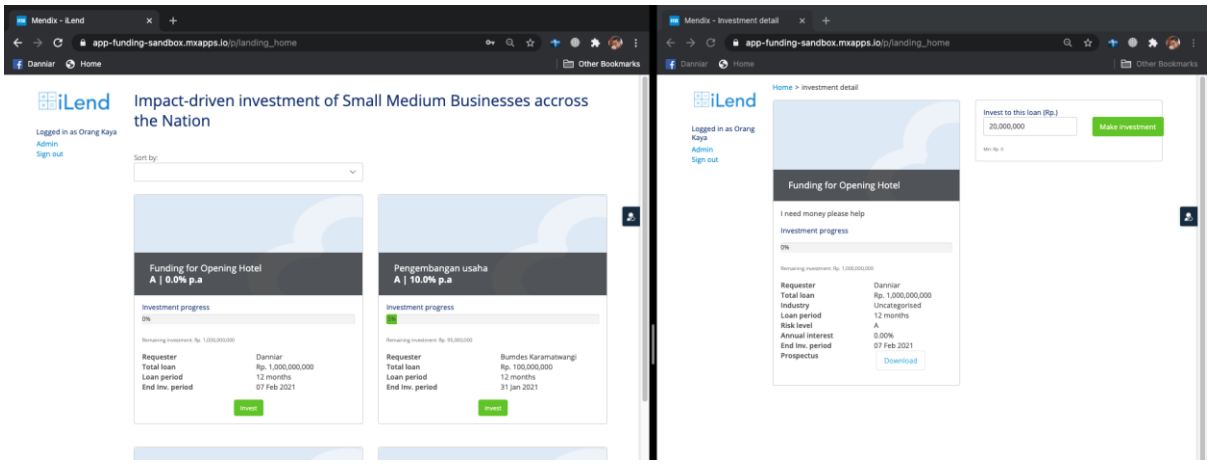

Figure 27 iLend Published Funding Request and Investment Placement

Tourism Content and Service Promotion

In respect to the promotion of the tourism content and service promotion, the Rural Platform has provided two different perspectives based on the role that the user is currently logged into the platform. The first role is when the administrator of the platform is logging in that is assumed to be taken by the Government Entity, then the permission to manage tourism content and information of the local rural region is provided. Through this collaboration initiative, these tourism contents and information will be shared with the partnered Tourism Platform where it will be used to enrich their content feeds regarding potential tourism spots. Meanwhile, the second role is assumed when the Rural Business Entities is logging in to the platform. They can register and promote their tourism services through the Rural Platform and the partnered Tourism Platform in a similar manner as the previously discussed Product and Transaction Synchronization. Both of these perspectives are being demonstrated in Figure 28 below, where the left side represents the promotion of the Tourism Content and the right side represents the promotion of the Rurals' Tourism Services.

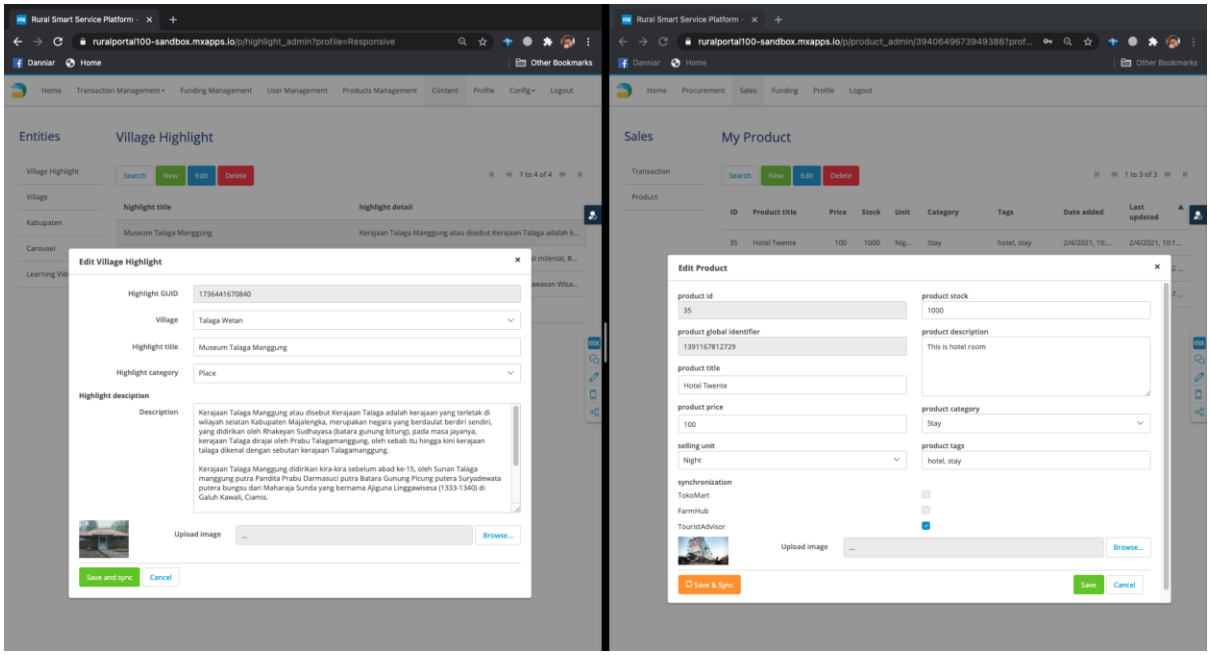

Figure 28 Rural Business Collaboration Platform Tourism Content & Service Promotion

The mentioned Tourism Platform, given the name TouristAdvisor, specializes in promoting tourism information and offering tourism services. The tourism services offered by this platform include bookings of accommodations (hotels, resorts, or guest houses), activities (outdoor sports, garden harvesting, or fishing), and events (shows, exhibitions, or concerts). In this platform, Rural Business Entity can register themselves as Tourism Agency that is able to register their tourism products and services to the platform and manages the incoming booking orders. In this platform, the Citizen can be the Tourist who discovers the published tourism products and eventually books the reservation. Moreover, to leverage the attractiveness of the published tourism products, this platform also advertises content related to tourism attraction and natural amenities of the local region.

As demonstrated in Figure 29 below, the upper part of the catalog in the TouristAdvisor's homepage shows the recommendation of tourism objects and spots that are being promoted by this Tourism Platform. This can take the form of either a place or an event, and can also be sourced from either internally or submitted by external application through the published web service, which in this case, is submitted by the Rural Portal. On the lower part of the page, the platform exhibits tourism services promotions that are offered by Tourism Agency, which can also promote the tourism services that are offered by the Rural Business Entities through the similar product and transaction synchronization scheme as used in the previous product and transaction synchronization.

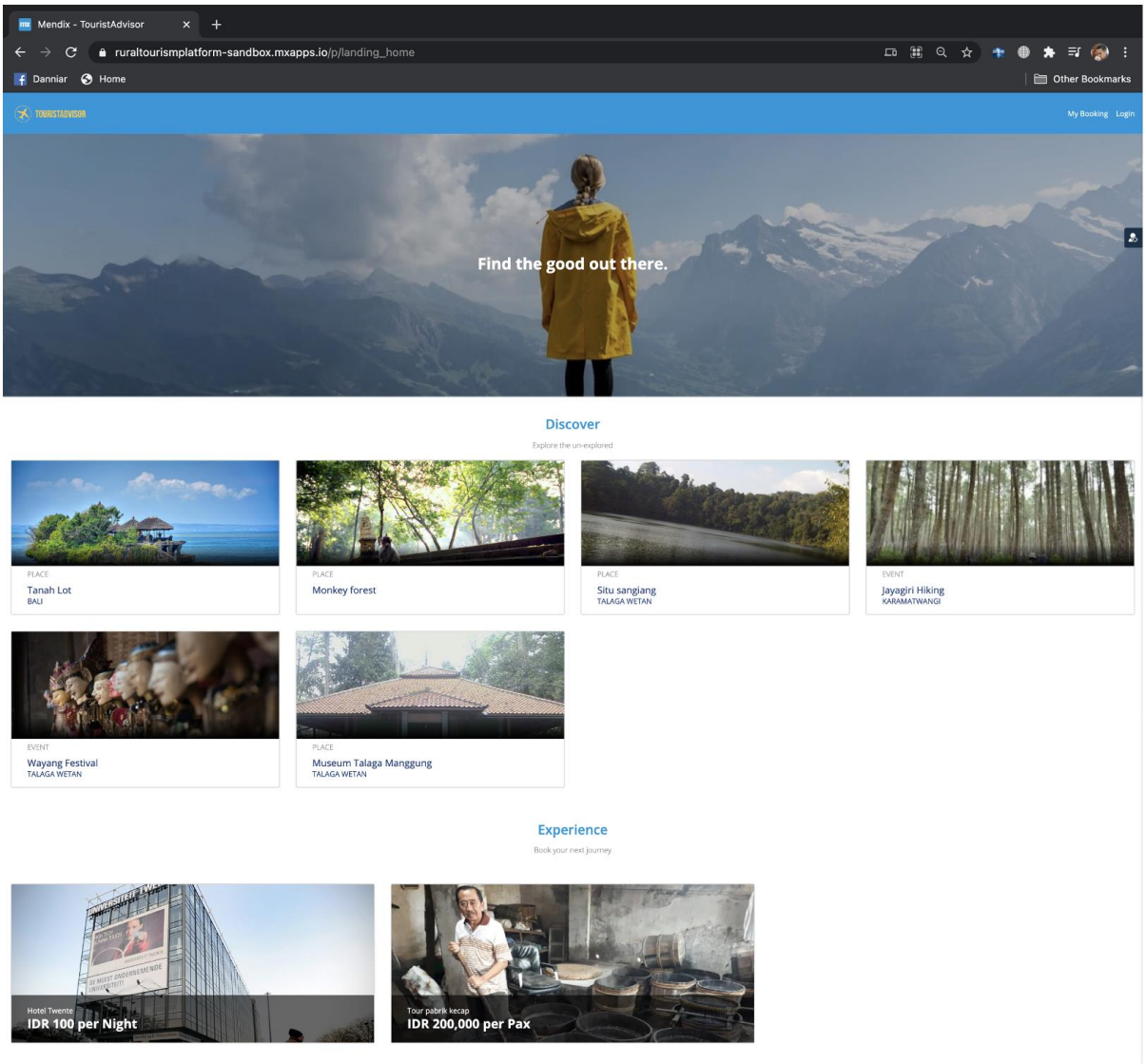

Figure 29 TouristAdvisor Tourism Promotion and Booking Platform

Enterprise Service Bus

Lastly, the orchestration of the services provided by these platforms is being facilitated by WSO2 Enterprise Integrator (EI), an integration platform that offers the essential features of an ESB. Among the numerous features supported by WSO2 EI, message transformation and message routing are being used in this scenario. Message transformation serves the purpose of transforming the data format of the message payload to the format required by the destination application. While message routing is required to facilitate routing of the message payload received by the ESB to the appropriate platform of platforms.

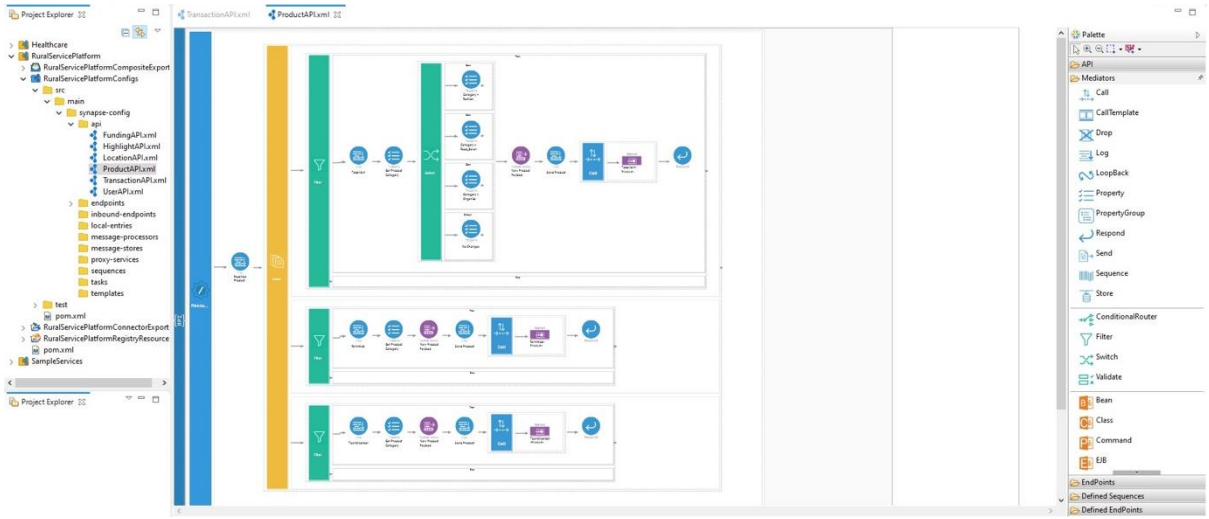

Figure 30 WSO2 EI Message Transformation and Message Routing

Figure 30 above shows the process of message routing and transformation in the case of product synchronization, which is executed either after the Rural Business Entity registers their product on the Rural Portal or when there is a change in the product information as mentioned earlier. This product-related service orchestration is initiated by first duplicating the received message payload into the number of the available marketplaces, which in this case corresponds to TokoMart, FarmHub, and TouristAdvisor respectively.

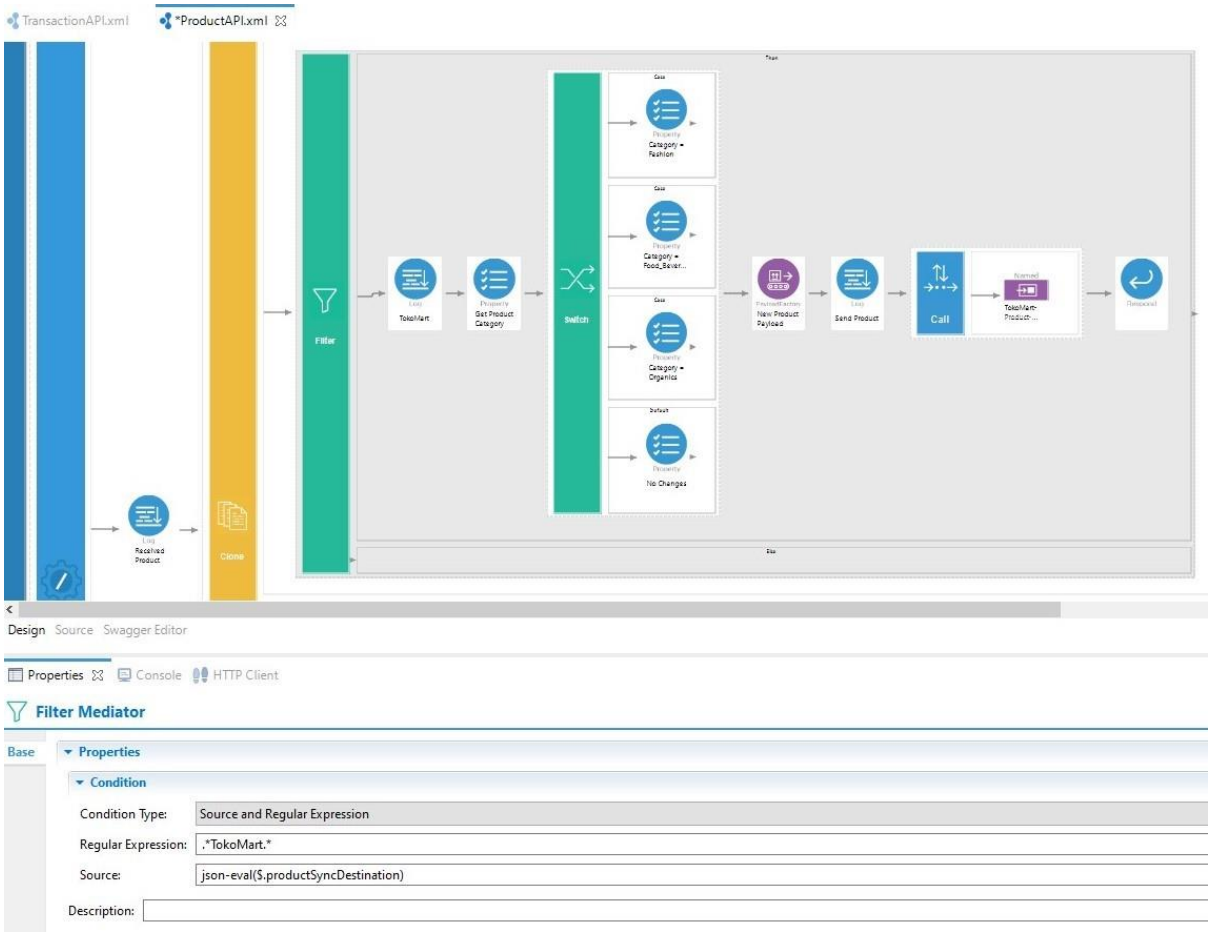

Figure 31 WSO2 EI Message Routing

Figure 31 above demonstrates that when the message payload specifies that the productSyncDestination field contains the keyword 'TokoMart', which means that the product is intended to be synchronized with TokoMart, then the message will be further routed to the corresponding platform's endpoint. Further is to transform the original message payload to adjust with the data format that is required by TokoMart's platform. In this scenario, the demand is demonstrated with the transformation of the 'productCategory' field. Figure 32 below explains that when the category is 'Clothes_and_Fashion' for example, then it will be replaced by the category of Fashion. Thereafter the flow is proceeded by assembling a new message payload that is following the payload fields known to the destination's platform and finalized with calling Tokomart's endpoint to update the synchronized product.

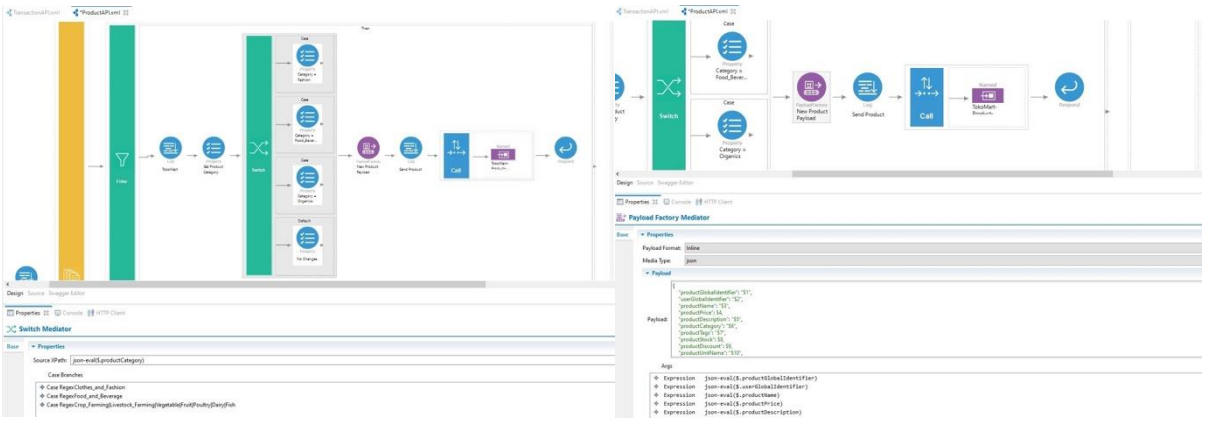

Figure 32 WSO EI Message Transformation

Through this message transformation supported by the ESB, the Rural Portal is benefitted from the concern of diverse data format that is being used by the partner 3rd party platform. A further possibility of this product category transformation case is that, whenever there is a new platform joined into the collaboration network or there is a new product category that has not yet been accounted for by the Rural Portal, then the ESB can trigger the API in Rural Portal to create a new one.

5. Validation of SOBC Platform for Rural Business Ecosystem Concrete Architecture

This chapter describes the attempt to discover the effects that emerged from using the reference architecture through the instantiation into a concrete architecture applied to a case study. This process is being done by presenting the proposed concrete architecture to the stakeholders of the selected case study, allowing them to examine and validate how the proposed architecture corresponds to the real-world context. This process acts for the treatment validation phase of the design science engineering cycle, in which, in this thesis, the research method of Single-Case Mechanism Experiment is being used to test how the validation model will perform when applied to a single object of study. The validation model, in this case, consists of the architecture prototype developed in the previous chapter that is interacting with a simulation of the intended context, which is the rural business ecosystem of the West Java Digital Village Program.

Further, in order to measure the performance of the validation model, R. J. Wieringa (2014) has noted that the measurement variables and their scales should be defined. To specify the measurement variables to be used in this validation scenario, the goal of this thesis is being recalled. Since the goal of this thesis is to introduce SOBC platform to a rural business ecosystem, then from the perspective of the stakeholders of the selected case study, the proposed architecture can be validated by investigating the extent that the proposed concrete architecture and its prototype implementation satisfies the defined goals or meets the identified common requirements in implementing business collaboration platform for rural business ecosystems, particularly the goals or requirements that are specified in the Motivation Viewpoint of the reference architecture. In this regard, a set of hypotheses are formulated in the following section in order to provide the basis if the predicted effects as proposed in the reference architecture will be perceived by the stakeholders in the case of the West Java Digital Village Program.

5.1. Hypotheses

The first aspect of the validation takes into account the extent that the proposed concrete architecture and its prototype have satisfied the specified common requirements defined in Motivation Viewpoint represented as Figure 8 in Section 3.3.2 earlier. Due to the nature of measuring the extent that the proposed architecture meets the requirements, this first validation aspect will follow the research method of a single-case mechanism experiment. This method is being used since this method is aiming to explore the response of an artifact in its intended context by building and applying the artifact prototype to a particular scenario of the real world.

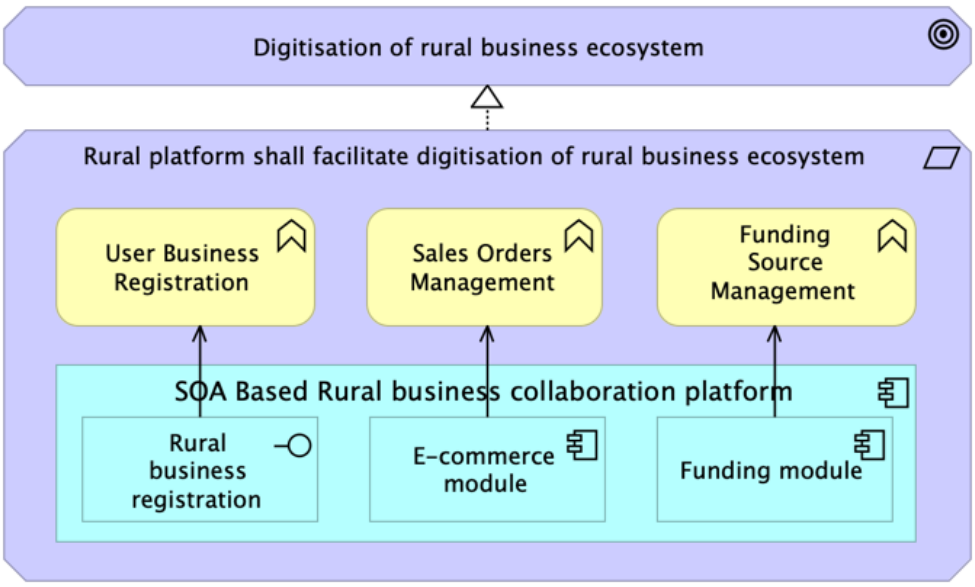

Figure 33 Rural Business Ecosystem Digitization Requirement

From the Motivation Viewpoint earlier, the first requirement of the business collaboration platform implementation for rural business ecosystems is that it should facilitate the digitization of a rural business ecosystem. The low provision of collaboration supporting IT is causing the rural businesses' value proposition to hardly be discovered by the potential partners and customers since their product or service offerings are not yet published online. This limitation is considered as a barrier for rural businesses to engage in the collaborative digital business ecosystem that was aimed to improve their economic welfare.

In order to improve this situation, the provision of a rural business collaboration platform that facilitates the digitization of rural businesses' offerings and enabling information exchange with potential partners along the way is required. Figure 33 above presents the viewpoint of how the rural business collaboration platform is addressing the digitization of rural businesses' offerings. In the proposed concrete architecture for the case of the West Java initiative, this digitization is being facilitated by the ability for rural businesses to register for a user account in the platform. This, in turn, enables them to digitize their products and tourism services to the platform. The ability for them to apply for a funding request should also be provided. Hence, the first hypothesis is then formulated as: ***The digitization of rural business ecosystem by the Rural Platform lowers rural businesses' entry barrier to engage in a collaborative digital business ecosystem [H1]***

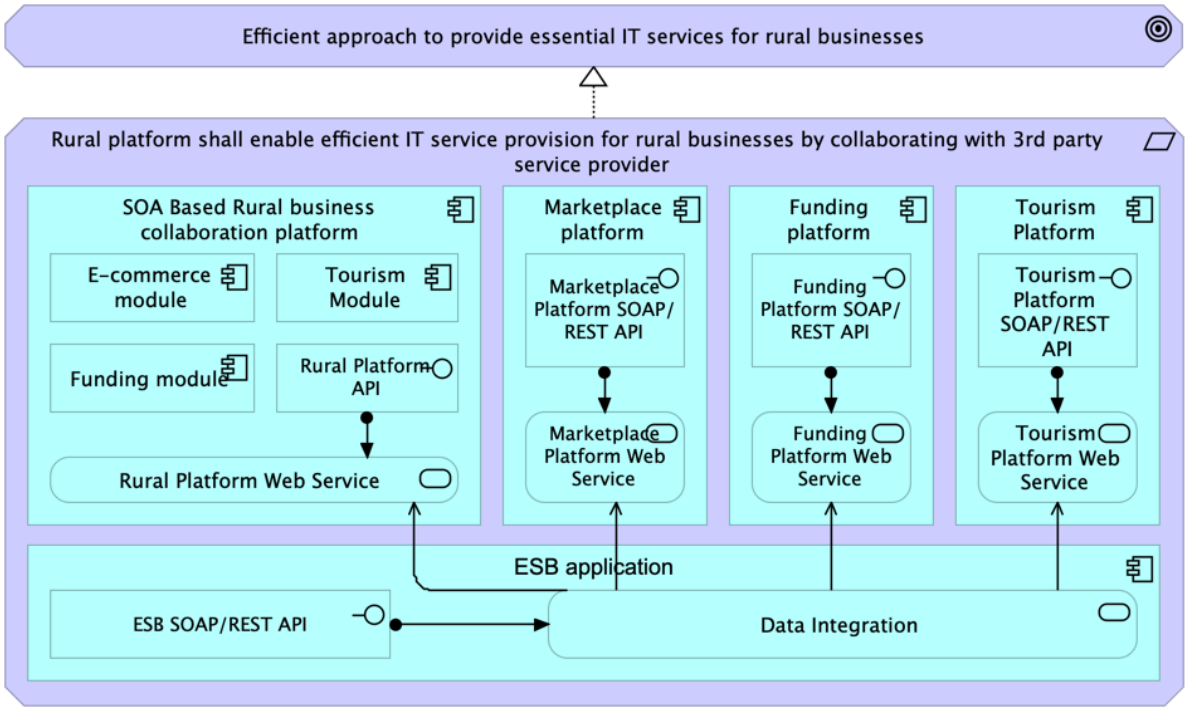

Figure 34 3rd Party Collaboration Requirement

Following the digitization course of action, the second requirement is concerned with how the platform should be provided or how the development initiative can be initiated. Sari et al. (2018) mentioned that most of the time, the initiative to provide or develop information systems for rural was initiated by the government agency. The issue is that their capability to develop essential IT services for rural businesses tends to be inadequate in comparison to the more matured capability possessed by the 3rd party IT-based enterprises that are actively competing in the industry. This phenomenon suggests that the government entity should collaborate with the 3rd party service providers in order to efficiently provide the said vital IT services for rural businesses.

Figure 34 above shows how the proposed collaboration between the rural platform and the essential 3rd party platforms supported by the ESB's data integration service is addressing this second requirement. It is then conjectured that the collaboration with 3rd party platforms essential to rural businesses such as Marketplace, Funding, and Tourism Platform is the efficient approach to lower the government barrier in providing vital IT services for rural businesses. In relevance to this conjecture, the second hypothesis is then formulated as: ***The collaboration of the Rural Platform with 3rd party platforms efficiently lowers the government's resource and capability barrier in providing the essential IT services for rural businesses [H2]***

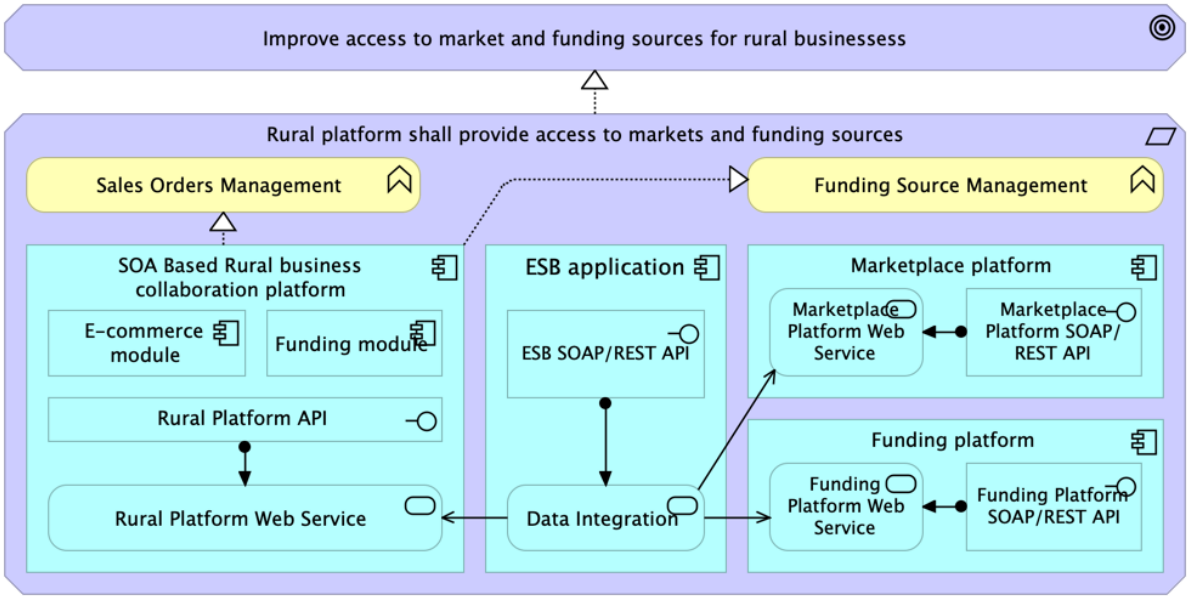

Figure 35 Market Access and Funding Source Requirement

The third requirement refers to what Banek et al. (2008); Sari et al. (2018) have stated regarding the demand by the rural businesses for improved access to market their product offerings and request funding to finance their business operation and expansion. Figure 35 above represents how the proposed architecture aims to satisfy these demands by integrating the rural platform with 3rd party marketplace and funding platform. This integration, supported by the ESB application, enables the rural platform to realize the management of sales orders and funding sources business function and provide them to rural businesses in a centralized platform.

Furthermore, through this integrated approach, the 3rd party funding platform is being shared the sales performance information of the rural businesses who request funding support through the rural platform. This approach is then conjectured to increase the attractiveness of the rural businesses as a viable investment opportunity and lower the barrier for them to expand their business, which is then formulated as the third hypothesis of ***The collaboration of the Rural Platform with 3rd party Marketplace and Funding Platform in providing integrated Sales Orders and Funding Source Management increases rural businesses attractiveness and lowers their barrier for expansion [H3]***

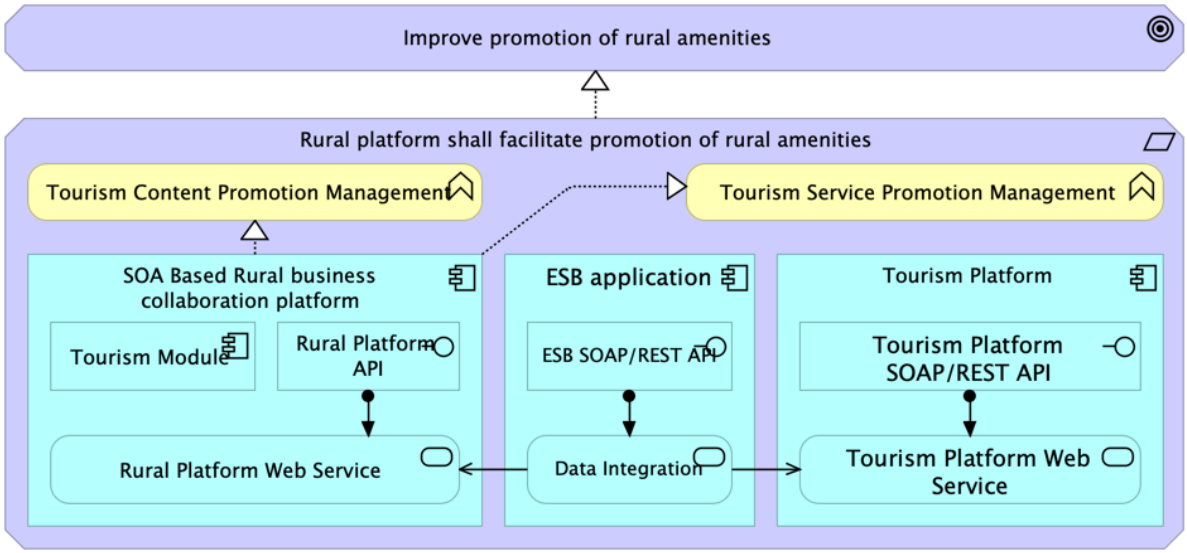

Figure 36 Tourism Content and Service Promotion Requirement

The next requirement is related to what Cunha et al. (2020) have noted regarding the ability of the rural region to showcase and promote rural uniqueness and tourism potential in their area in order for them to attract potential tourists and investors. This requirement facilitates the means for the rural region to promote both their regional highlights such as natural beauty and cultural heritage and the tourism products operated by rural businesses who offer services such as tourism accommodation and activities in rural areas.

Figure 36 shows how the proposed architecture attempts to satisfy this requirement by integrating the rural platform with 3rd party tourism platform. Through this application integration approach with the 3rd party tourism platform, the rural platform is able to provide tourism content and tourism service promotion management, enabling the rural region to promote both their regional highlights and rural businesses' tourism products. Taking into account what Cunha et al. (2020) have mentioned about ICT being the catalyst for rural regions promotion, then this proposed approach is being used as a base for the fourth hypothesis, stating that: ***The collaboration of the Rural Platform with 3rd party Tourism Platform in providing integrated Tourism Content and Tourism Service Promotion Management increases the attractiveness of tourism in a rural region [H4]***

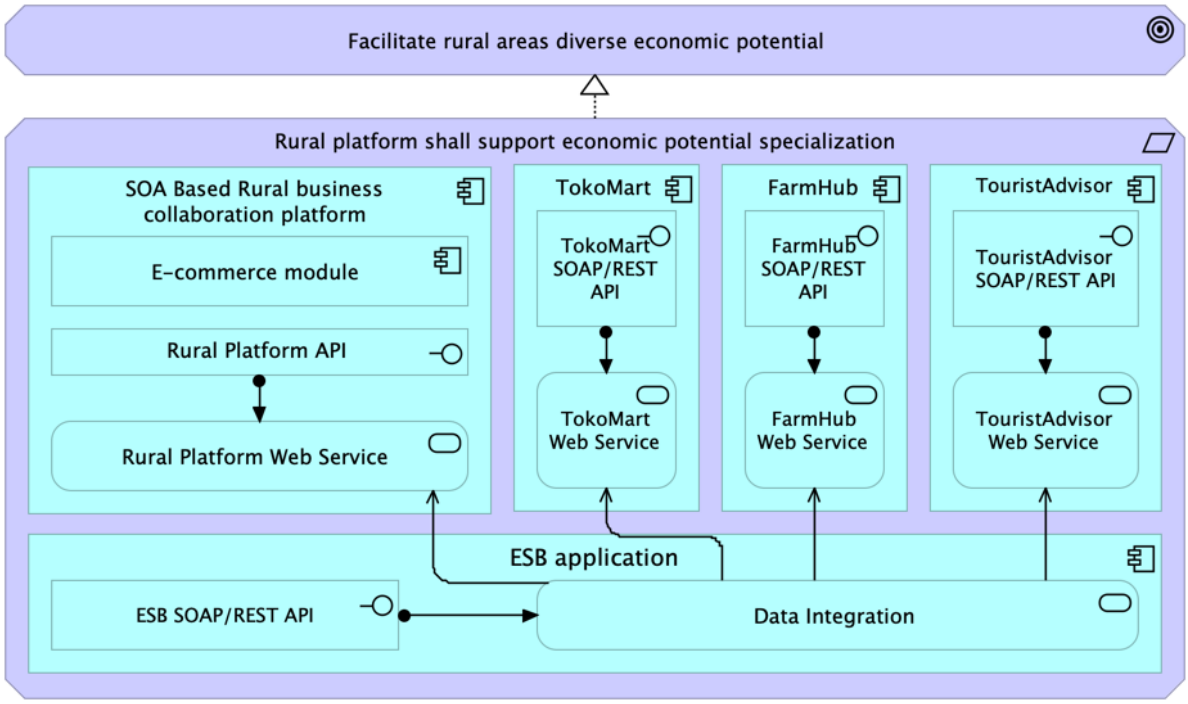

Figure 37 Potential Economic Specialization Requirement

The last requirement concerns how rural regions' diverse economic potential can be supported and leveraged. Naldi et al. (2015) have suggested earlier that rural economic specialization can be achieved through the provision of appropriate technological infrastructure. This said IT infrastructure should be able to connect supplies from rural businesses' to demands in an urban area and further promote rural regions' diverse economic potential. In this thesis, the proposed IT infrastructure takes form in the development of Rural Platform working prototype and is being demonstrated to collaborate with a number of 3rd party platform focusing on different specialization.

Figure 37 above presents how the Rural Platform collaborates with the 3rd party platforms that are developed for this case with the aim to facilitate the rural region's economic potential specialization. Two platforms, as the instantiation of Marketplace Platform, are provided. The first one TokoMart serves as a marketplace for general products, while the FarmHub serves as a marketplace that is specialized in farming products. TouristAdvisor is an instantiation of Tourist Platform, which exists to promote and offer tourism services to potential tourists, in addition to promoting tourism highlights. However, in relevance with this requirement of rural economic specialization, the prototype implementation earlier demonstrates this specialization as the selection of product-marketplace synchronization based on the product category. This demonstration, in turn, is conjectured to lower rural businesses' barriers to gain access to the specialized platform in marketing their proposition. In conjunction with this, this fifth hypothesis is being formulized as, ***The collaboration of the Rural Platform with the specialized 3rd party platforms lowers rural businesses' barrier to gain access to the specialized market in marketing their proposition [H5]***

5.2. Validation Scenario

Subsequently, the defined hypotheses above are to be validated by conducting a workshop session with stakeholders of the West Java Digital Province Initiative. The stakeholders participated in this workshop session is consisted of:

A. Head of Communication and Information Office of West Java Province (Diskominfo Jabar), as the project owner
B. Executive Director of West Java Digital Service Division of Diskominfo Jabar
C. Head of Implementation of West Java Digital Service Division of Diskominfo Jabar
D. A representative from the lead of the West Java Rural Development Program
E. A representative from the 3rd party marketplace service provider
F. A representative from the 3rd party lending service provider

The workshop is conducted by first presenting the proposed architecture to these stakeholders. The first architecture that is being presented in this workshop is the motivation viewpoint proposed in Figure 8 earlier in order to establish a shared view of traceability between the identified challenges in the provision of a rural business collaboration platform, its requirements, and the proposed solution to these requirements. Next, is to present the concrete architectures, which are proposed in Figure 15 until Figure 19 previously, as scenarios that guide the development of the working prototype in satisfying the defined requirements of the motivation viewpoint.

The participating stakeholders are then being presented with the usage demonstration of the working prototype as well as given the opportunity for them to use the prototype. After the presentation and demonstration of each of the viewpoints instantiated as scenarios in this workshop session, each of the participants is being interviewed with a set of questions that correspond to the extent that the proposed architecture and its prototype can satisfy the defined requirements. How these questions are constructed and how the responses of each of the questions are measured, will be discussed in the next section.

5.3. Measurement Design

In order to validate the defined hypotheses and measure the response from the validation model, this research employs a qualitative analysis that analyses the data gathered from interviewing the project stakeholders after presenting the architecture and demonstrating the prototype. The interview format is designed to follow the standardized open-ended interview format, which asks identical questions to all of the participants that enable them to elaborate as much detailed information as they desire and allows the researcher to ask follow-up questions (Turner III, 2010). Each of the questions for the interview is then formulated to correspond to answer each of the previously defined requirements that are also listed in Table 12 below.

Table 12 Validation Pointers based on Motivation Viewpoint's Requirements

No.	Requirements	Questions	Score	Positive Opinion	Negative Opinion
1	The rural platform shall facilitate digitization of the rural business ecosystem	- To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?			
2	The rural platform shall enable efficient IT service provision for rural businesses by collaborating with 3rd party service provider	- To what extent is the platform architecture expected positively contribute to make rural services provision efficient?			
3	The rural platform shall support economic potential specialization	- To what extent is the platform architecture expected positively contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?			
4	The rural platform shall provide access to markets and funding sources	- To what extent is the platform architecture expected positively contribute to improving rural market access?			
5		- To what extent is the platform architecture expected positively contribute to improving access to funding sources?			
6	The rural platform shall facilitate promotion of rural amenities	- To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?			

The validation pointers in Table 12 above are given to the participants as a form of a questionnaire and listed out under the intention to measure the response from the participants in relevance with measuring the requirements' satisfaction level of the working prototype as opposed to the concern of lowering the rural businesses' entry barrier towards participating in a collaborative business ecosystem. Moreover, in order to quantify the level of participants' approval, Likert Scale from the scale of 1 to 5 indicating 'requirement is not met' for the score of 1 and 'requirement is fully implemented' for the score of 5 under the column of 'Score' is used. The result from this Likert Scale also contributes towards discovering the average level of the participants' approval towards the requirements satisfaction as well as the variance of their diverse responses using standard deviation.

Furthermore, in regards to allowing the participants to elaborate on their opinion as much detail as they desire and allowing the researcher to follow up on the insight as further as possible, two additional columns of positive and negative opinions are provided. These positive and negative opinions from the participants can be mutually inclusive, or in other words, the participants can give a low score for the requirements satisfaction level but still provide an opinion of the requirement's relevance or importance towards the real-world context. In the case of analyzing the response, the obtained score for each response from each participant are being averaged and later the averaged result will be interpreted based on its interval range.

5.4. Analysis and Result

The analysis from the interview result is performed by first describing the result from the questionnaire above. In this section, the mean that indicates the overall trend as well as the standard deviation that illustrates the variance between the participants' responses is being highlighted. Based on the obtained results as shown in Table 13 below, the mean for each question ranges from 4.2 to 4.5, where the lowest mean value is recorded for Q1 and Q6, while the highest mean value is documented by Q2 and Q4. In addition, in terms of the standard deviation, the obtained value ranges from 0.41 to 0.75. If a value of standard deviation equal to zero is considered as a strong agreement among respondents and the value higher than 1 means that there is a strong variation among their response is being taken into account, then the obtained range of values for standard deviation below indicate that there is a relatively strong agreement among the participants in approving the requirements' satisfaction level.

Additionally, as part of the interview process and validating the defined hypotheses above, the respondents are also requested to provide their opinion towards the proposed architecture represented by the working prototype. The obtained descriptions are then discussed in the following sub-sections. Meanwhile, the transcript of the respondent's responses is attached and can be referred to in Appendix A.

Table 13 Questionnaire Results

No	Questions	A	B	C	D	E	F	AVG	STD DEV
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	4	4	5	4	4	4	4.2	0.41
2	To what extent is the platform architecture expected positively contribute to make rural services provision efficient?	4	4	5	4	5	5	4.5	0.55
3	To what extent is the platform architecture expected positively contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?	5	5	4	4	5	4	4.5	0.55
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	4	5	5	4	5	4	4.5	0.55
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	4	4	4	4	5	5	4.3	0.52
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	4	4	4	5	5	3	4.2	0.75
		AVG		4.4		STD DEV		0.54	

5.4.1. The digitization of rural business ecosystem by the Rural Platform lowers rural businesses' entry barrier to engage in a collaborative digital business ecosystem [H1]

In regards to the first requirement of facilitating digitization of rural business ecosystem, participant D as the lead of the West Java Development Program concurred that a lot of businesses in a rural region in running their operations have not yet been supported by the use of ICT and even less supported by IT services that enable collaboration with either 3rd party platform providers or their peers. He believes that through this rural platform, the required process of rural businesses digitization, which is essential for them and their offerings to be discoverable by the market, can be facilitated. This statement is also supported by participant F, who is a representative of the 3rd party marketplace platform provider. He perceived the proposed architecture and the prototype as a pipeline to highlight and promote the value propositions of businesses in rural to the customer demands in urban or another region, making the existing pipeline to be more optimal in making these businesses discoverable.

However, at the same time, this issue of limited technology penetration to rural businesses is also caused by the rural businesses' lack of knowledge and literacy in using any ICT to support their business. This is aligned with what participant C, as the Head of Implementation of Digital Service Division of West Java Communication and Information Office, has made clear. He stated that this goal of rural businesses digitization needs to also consider how to bridge the gap between the required capability to operate with the provided IT services with the minimum level of digital literacy currently exist in the rural region. Although, this situation in West Java's case is planned to be tackled by arranging a rural community service from the higher educated society such as from government agents or bachelor students carrying out internship program in order to induce knowledge transfer to these rural businesses, which in turn further lowering the barrier of rural businesses to participate in a digital business ecosystem.

Nevertheless, despite the need to consider the gap of digital literacy in the real world case, all respondents have approved that the proposed architecture will facilitate the digitization of the rural business ecosystem, which contributes to lowering the barrier for rural businesses to engage in the collaborative digital business ecosystem. This statement is also supported by the obtained average score of 4.2 with a standard deviation of 0.41, indicating that there is a small variance among their responses.

5.4.2. The collaboration of the Rural Platform with 3rd party platforms efficiently lowers the government's resource and capability barrier in providing the essential IT services for rural businesses [H2]

In relevance with the requirement of lowering the government's limitation in providing the essential IT services for rural businesses, participant C with the perspective of the governmental Digital Service department agreed that the presented prototype enables to demonstrate how the proposed architecture facilitates quicker product launch, in this case, the launch of the rural platform, compared to building the whole platform with all functionalities and capabilities from scratch. This trait is even more accentuated in the current pandemic situation when the government's human and capital resources have been occupied mostly for COVID-19 measures, the collaboration between public-private sectors becomes a substantial approach. In addition, he mentioned that in a real-world situation, it is common

to also consider the mechanism and roadmap to implement the collaboration initiative with the 3rd party service providers. In relation to the proposed or the reference architecture, this concern takes place in the perspective of either application or business layer, which in ArchiMate it will be translated to the Implementation and Migration Layer.

In relation to this concern, participant C questioned whether the intention to collaborate with 3rd party service provider has been consulted with representatives from the 3rd party service provider before in regards to their willingness to collaborate. For the simulated context defined in this research, participant E elaborated from the perspective of a representative of 3rd party lending service provider, stating that this form of collaboration brings a positive impression to the 3rd party service providers since the rural platform has the potential to bring an additional source of Gross Merchandise Value (GMV) for these 3rd party service providers. Although, it should also be noted from participant E and F that in this collaboration architecture, 3rd party service providers are usually less willing to adjust and requires the platform provider, or the developers from the government side, in this case, to adjust to their proprietary business processes and application services. In this scenario, the use of ESB is then perceived to tackle the challenge of data interoperability and service orchestration due to the diverse proprietary application processes and services.

In addition, participant F believes that enabling modularity of the rural platform as demonstrated in this architecture, in relation to establishing a partnership with 3rd party service providers, will improve the government's efficiency in improving rural businesses' market access as well as to strengthen public-private collaboration ecosystem. Participant B, who acts as the Executive Director of West Java Digital Service, shared his concern in regards to the potential unsustainable business model if the rural platform is going to be maintained fully by the government. While it is true that government-initiated programs can be welcomed by the rural businesses, but the fact that a government-formed agency such as West Java Digital Service is prohibited to be profit-driven, sustainability of the IT service provision is questionable. In this case, the partnership with 3rd party service provider is a favorable approach due to their tendency to adopt market-driven innovation.

To conclude, despite the notable concern regarding the 3rd party service provider's willingness or commitment to participate and how to tackle the anticipated issue of data interoperability and service orchestration, all respondents have approved that collaborating with 3rd party as illustrated by the proposed architecture facilitates the government intends to lower their resource and capability barrier in provisioning the rural platform for rural businesses. This statement is backed up by the obtained quantitative data, which is averaging in the score of 4.5 with 0.55 of standard deviation, indicating small variance among their responses.

5.4.3. The collaboration of the Rural Platform with 3rd party Marketplace and Funding Platform in providing integrated Sales Orders and Funding Source Management increases rural businesses attractiveness and lower their barrier for expansion [H3]

Participant C had made clear that this sales order part of the proposed architecture is aligned with the current priority of the Digital Village initiative by the government, which is focused on lowering the rate of urbanization and increase the willingness of the local population to develop local businesses or attract entrepreneurs to develop businesses in the rural region. This issue of an increasing rate of urbanization is perceived to be caused by the

lack of market access in the rural region, which is causing the businesses in the rural region to be hardly discoverable by the potential customers.

Participant D, as the lead of the West Java Rural Development Program, perceived that through the integration of this rural platform with 3rd party marketplace platforms, the rural businesses will obtain the market access that they need. To bridge the gap of digital literacy between the rural businesses and the rural platform, he envisioned that government agencies acting as the administrator of the rural platform can be deployed in rural regions to establish and manage an order fulfillment center in each of these rural regions. This notion has been facilitated by the proposed architecture and the working prototype, which is about the Sales Orders Management business function along with the proposed business processes arranged in it.

In relevance with the issue of financial support for rural businesses to sustain and grow, participant D conveyed that most smaller and newer rural businesses are having difficulties in applying for funding support from banks due to their un-ability to provide proof of their business performance. Through the working prototype, Participant B views this architecture as the enabler for the rural businesses to appeal to funding provider in order to get funding support, since the rural platform will be able to gather the rural businesses' sales transactions data from multiple marketplaces in a centralized platform and subsequently provide it to the partnered 3rd funding platform, improving these rural businesses credit score assessment in the end. This collaboration initiative is perceived to be a positive approach as well due to the fact that the rural platform, where the sales transactions and funding application is registered, is monitored by the government and desirably that the government will be able to sort out which businesses are critical to getting more support.

Participant E, from the perspective of 3rd party lending service provider, agrees with this view and stated that this proposed architecture happens to be the current business model in the lending or financing industry. In common practice, banks need to channel their credit funds, but at the same time, they also require the means to assess the credit risks of their lenders. By acquiring and offering sales transaction or business performance data of the rural businesses to the lending platform, the assessment of credit risk is believed to be improved. Participant F added insight into this matter, stating that there are 2 types of financial data that are currently being demanded by the industry. In addition to the formal data, mostly, alternative data is the complementary data they needed to improve their risk management process. Alternative data is regarded as all digital activities that are recorded by or from any digital or physical platforms. Through this rural platform, the lending platform expects that the unique digital activities of rural businesses will be captured. However, a note to be considered from participant B's input is that in a real-world scenario, most of the time, the common business process for credit risk assessment underwriting will be more complex.

Overall, most of the participants agreed that the collaboration between the rural platform with 3rd party marketplace platform will increase their needed market access. This statement is supported by the average score of 4.5 with a standard deviation of 0.55, indicating a small variance among their responses. Moreover, all respondents also agreed that by providing these rural businesses access to the partnered 3rd party funding platform and sharing their sales transaction data such as illustrated by the proposed architecture and demonstrated by working prototype, rural businesses will appeal better to the potential investors and lower their barrier to expand. These statements are supported by the obtained qualitative data that is averaging in the score of 4.3 with the same standard deviation score of 0.52.

5.4.4. The collaboration of the Rural Platform with 3rd party Tourism Platform in providing integrated Tourism Content and Tourism Service Promotion Management increases the attractiveness of tourism in a rural region [H4]

Regarding the concern to increase the attractiveness of tourism in a rural region, the opinions from the respondents will be divided into two categories. The first category, which is concerning tourism content promotion, is perceived by participant B as an intriguing concept. Although, the strategic management and the operational model should also be carefully planned beforehand. An example of this would be the government agents generate the seed information of tourism highlights in a rural region through the rural platform and then it feeds this information to tourist or vlogger forums in order to invite them to contribute to generating reviews of the promoted tourism spots through this rural platform. Therefore, a word-of-mouth (WOM) form of marketing is expected to increase the attractiveness of rural tourism.

This suggestion is also aligned with what participant E has suggested, which is to enable the rural platform to receive and display tourist comments and testimonials of their visit to the promoted tourism spots, since these types of information will be essential to attract other tourists to visit and for the government and the venue manager to improve their tourism service quality. Subsequently, participant B also believes that this tourism content promotion can lead to enabling cross-selling in a rural business ecosystem by referring these tourism spots in rural to the relevant products or services offered in the surrounding area of the highlighted tourism spot.

In regards to the second category that concerns the promotion of the tourism service, participant D stated his belief that the collaboration initiative between the rural platform with 3rd party tourism platform is required in the case of the West Java Digital Village program. This promotion will be an advantageous approach both for the rural businesses as well as the government in realizing the success of the program since the government has been organizing the program to develop Tourism Village, which is currently made up roughly 20% of the population of all registered rural businesses in West Java. However, a sidenote from participant B regarding the tourism service promotion is that there is a potential that the 3rd party tourism platform in the market right now is currently less ready to open their APIs compared to the retail marketplace. Hence, in the short future, the promotion effort for tourism should be focused more on promoting content about rural tourism.

In conclusion, even though not all of the participants have provided their opinion regarding the rural tourism promotion, most of them agreed that the collaboration of the rural platform with the 3rd party tourism platform will increase the attractiveness of tourism in a rural region. This statement is further supported by the obtained average score of 4.2 with a standard deviation of 0.75, indicating that there is a slight but notable variance among their responses, which is reflected by some of the participants' opinion regarding prioritizing the tourism content promotion over the tourism service promotion and the lack of elaboration on tourist comments and testimonials.

5.4.5. The collaboration of the Rural Platform with the specialized 3rd party platforms lowers rural businesses' barrier to gain access to the specialized market in marketing their proposition [H5]

In respect to lowering rural businesses' barriers to gain access to a specialized market, participant D provided data regarding the prioritized rural businesses' sector by the West Java government. Based on the summary of the currently developed sectors of rural businesses, agribusiness and tourism sectors are the two biggest contributors to the rural economic development of West Java, which takes up the portion of 35.3% and 15.7% respectively as compared to 5 other rural business sectors such as culinary, craft, rental, etc. This information justifies the decision for this rural platform to collaborate with the specialized farming marketplace and tourism platform, as demonstrated by the proposed architecture.

Additionally, participant E shared his opinion from the perspective of 3rd party marketplace, stating that lately the buyers or online shoppers are spread out across multiple marketplaces due to the diverse targeted market segmentation of the different existing marketplaces. Consequently, sellers are demanded to approach their target consumers across multiple marketplaces nowadays. Due to this fact, a platform that offers the ability to manage multiple sales channels, which is commonly known as an omnichannel platform, is currently also in high demand in the industry. An approach offered by this type of platform is perceived as a suitable approach for this requirement of providing rural businesses' access to the specialized market as demonstrated through the ability to synchronize the product into the selected or specialized marketplace relevant for that product.

Overall, despite the minimum elaboration by the rest of the respondents on this matter, all of them have provided their approval that the collaboration of the rural platform with specialized 3rd platforms such as specialized farming marketplace and tourism platform will be able to lower rural businesses' barrier to market their specialized proposition. This statement is further supported by the obtained average score of 4.5 with a standard deviation of 0.55, indicating that there is a slight but notable variance among their responses.

5.4.6. Future Concerns and Improvement

A side note from participants B and E that may reflect on the improvement of the proposed architecture is that further iteration should also consider the inclusion of warehouse and stock management module to form a more complete solution. In respect to the context of SOBC and the goal of lowering the stakeholder's entry barrier, this provision has the potential to lead the IT provision initiative to a collaboration with another specialized 3rd party warehouse management provider and this happens to be aligned with one of the identified business functions in the SLR of this research that has not been elaborated yet.

However, another concern that arises under the notion of data synchronization with 3rd party platforms is the issues of "redundancies" in sales order management and "inconsistencies" in the stock management. Redundancies can occur when there are more than one incoming orders that came from different platforms but are similar or generated by potentially the same customer. Where inconsistencies happen when the product stock amount is different among different platforms that are potentially caused by faulty synchronization process. These issues are especially important for the real-world production environment later, since if there are even slight functional or data discrepancies between the rural platform and the 3rd party platform then the barrier for the rural businesses to engage in the digital business ecosystem will rise again.

6. Conclusion

This thesis has been carried out to address the main objective of the research on how to design a reference architecture of service-oriented business collaboration for the context of a rural business ecosystem. The delivered reference architecture for rural business ecosystem context consists of a motivation viewpoint, business roles cooperation viewpoint, business services cooperation viewpoint, sales applications usage viewpoint, funding applications usage viewpoint, and tourism applications usage viewpoint.

The overall structure of this research follows the design science research methodology as explained in section 1.4.4, in which its cycle is being initialized by problem investigation through specifying the research questions. Followed by treatment design that is marked by the stipulation of the requirements in realizing the goals as mentioned in the motivation viewpoint earlier, the design of the reference architecture as well as the proposal of the concrete architecture and its instantiation into a working prototype for the case of West Java Digital Village program. The design of the reference architecture itself follows the integrated reference architecture design framework as explained in section 1.4.3 previously. While the treatment validation was performed by conducting interview sessions and gathering the participants' responses in regards to the satisfaction level of the proposed architecture as opposed to fulfilling the defined requirements.

6.1. Research Questions

RQ1 What is the state-of-the-art in Service-Oriented Business Collaboration platform reference architecture?

To discover the current state of the art reference architecture of Service-Oriented Business Collaboration, a systematic literature review that explores relevant scientific journal articles from the past two decades is performed in this research. This literature review is also performed in order to discover the essential constructs for SOBC. During the literature review, it is discovered that the adoption of SOBC is mainly aimed to lower stakeholder's entry barrier to the market, increase connectivity among the stakeholders and enable partnership formation to fulfill sales orders through the facilitation of collaborative business functions. In relevance with the context of a rural business ecosystem, the goal of increasing entrepreneurship and diversification of businesses in the rural region to stimulate socio-economic growth are also identified. This goal is grounded by the identified concern of low information connectivity between stakeholders in a rural business ecosystem that eventually stimulates the need for business collaboration enabler technologies.

In addition, it is also discovered how an architecture of SOBC platform is commonly specified in previous studies along with the constructs that make up the architecture. The most notable architectural layers present in the observed SOA presented by previous studies consist of layers of business processes, integrations, services, applications, and technology infrastructure. In order to remove architectural layers redundancies commonly identified among SOA-related studies, these layers are then mapped to ArchiMate, which are eventually consisted of Business Layer, Application Layer, and Technology Layer. This decision is also taken to facilitate the integration of the proposed reference architecture with the motivation-related architectural layer that encourages the adoption of the SOBC platform.

Moreover, a number of common architectural constructs that make up each of the architectural layers are also identified. As the common motivational architecture constructs

that are related to the context of a rural business ecosystem have been elaborated earlier, the identified business functions in typical SOBC platform implementation commonly consist of Sales and Order, Production and Procurement, Warehouse and Stock Management, Distribution and Logistics, Payment and Financing, Marketing and Reputation Management as well as Data Analysis. Other common architectural components that make up the reference architecture in the layer of application and technology are the use of web services technology to facilitate data interoperability among organization's information system as well as the collaboration portal that is either desktop-based, web-based, or mobile-based application. Additionally, in order to facilitate service orchestration among these applications' web services, the use of ESB is commonly identified among the studies in the field of SOBC.

RQ2 How can the reference architecture of a Service-Oriented Business Collaboration platform for a rural business ecosystem be specified?

In order to design the reference architecture of SOBC for a rural business ecosystem, this research follows the integrated reference architecture design framework as explained previously. First, the goal that states the purpose of the design of the reference architecture is defined, which is to deliver a reference architecture for the provision of an SOA-based business collaboration platform that aims to increase information connectivity, inter-organizational services orchestration, and heterogeneous enterprise applications integrations for the context of rural business collaboration ecosystem. Additionally, this reference architecture is intended to be applied to *multiple organizations* in a rural business ecosystem, that may consist of government agencies, 3rd party service providers, and rural businesses, who share a common goal in establishing and enriching an SOA-based rural business collaboration platform with a set of collaborative business functions. Subsequently, referring to the reference architecture design framework by Angelov et al. (2012), this reference architecture is designed and specified in an abstract manner, meaning that the components contained in the architecture are specified in terms that generally specify its functionality.

Further, through an investigation from relevant research publications that focus on business development and collaborations in a rural context, a set of system requirements that make up the architectural requirements are listed and grouped in Table 11. These architectural requirements are then being used as a basis to build the Motivation Viewpoint of the reference architecture, which is assembled and grouped accordingly to the TOE framework as proposed by Tornatzky et al. (1990). Business Roles Cooperation Viewpoint in Figure 10 is presented to be used by the following viewpoints as the foundation of the interactions between business roles that follows the design principle of SOA, whereas Figure 11 is presented to elaborate on more details towards who maintains which Application Components, which Application Component realizes which Business Functions and who are to be the End Users of this rural business collaboration initiative.

Based on the specified Business Functions that are realized by the Rural Business Platform, 4 additional applications usage viewpoints are presented. These 4 viewpoints that consist of Sales Orders Management, Funding Source Management, Tourism Content Promotion Management, and Tourism Service Promotion Management are focusing on how the applications expose application services and communicate with each other through service orchestration facilitated by the ESB. Under the classification of a reference architecture, these viewpoints are designed to be processed agnostic that ignores the

detailed information regarding processes or other sequential activities, leaving the elaboration on the diverse real-world business processes implementation to the instantiation of the concrete architecture.

RQ3 How the concrete architecture of a Service-Oriented Business Collaboration platform be instantiated to support rural businesses in West Java Province, Indonesia?

The instantiation of the proposed reference architecture in Chapter 3 to the case of West Java Digital Province has been described in Chapter 4. The instantiation is carried out by first demonstrating how the reference architecture can be operationalized, which is by customizing the incorporated architectural constructs of each of the application usages viewpoint to suit the needs of the case study. This customization emphasizes exposing the previously defined business functions incorporated in each of the application usage viewpoints so that information regarding sequential activities such as business processes can be presented according to the case where the architecture is intended to be applied. Moreover, through this concrete architecture instantiation, the service orchestration between applications that are represented by the interactions between application processes served by each applications' web service can finally be materialized. These application processes, along with the other application components, are also shown their role in serving or realizing the corresponding business processes in the concrete architecture.

This concrete architecture is then being further instantiated into a working prototype in order to demonstrate how the reference architecture is being operationalized into the case study and so that it can be validated and evaluated by the stakeholders in the West Java Digital Province Initiative. All of the applications, the rural business platform, and the 3rd party platforms, are developed using Mendix and the orchestration of the services exposed by these platforms is being facilitated by WSO2 Enterprise Integrator (EI), which offers the essential features of an ESB. As described in Section 4.3, the business processes supported by these collaborating platforms can finally be realized and the services exposed by these platforms are successfully orchestrated by WSO2 EI through the message routing and message transformation functions that it supports. How the message routing and message transformation functions are being configured and leveraged in this prototype has also been elaborated in Section 4.3.

RQ4 What effects are produced by the implementation of the concrete architecture of a Service-Oriented Business Collaboration platform for a rural business ecosystem?

The reference architecture is being validated by presenting its instantiation into the proposed concrete architecture accompanied by the working prototype to the stakeholders of the selected case study, which allows them to examine and validate how the proposed architecture corresponds to the real-world context. In order to make up for the validation model, the working prototype is arranged to interact with the rural business ecosystem of the West Java Digital Village Program as a simulation of the intended context. The proposed architecture is then validated by investigating the extent that the proposed concrete architecture and its prototype implementation satisfy the goals or requirements that are specified in the Motivation Viewpoint of the reference architecture. In regards to this investigation, five hypotheses have been proposed and 6 questions were being asked to 6

interview participants, who represent the perspectives from government, rural business as well as 3rd party service providers, through an interview session.

As have been explained in Section 5.4, the interview result is being evaluated by highlighting the participants' average score as well as the standard deviation of each question. The average for each question ranges from 4.2 to 4.5 and the standard deviation for each question ranges from 0.41 to 0.75. This result shows that there is little variance among the respondents' responses. Although, some additional remarks in regards to validating each of the hypotheses were obtained in the interview as discussed in Section 5.4, which should be taken into consideration for both the real-world implementation as well as for further iteration. Despite these remarks, a conclusion can be drawn that all respondents have agreed that all requirements defined in the Motivation Viewpoint of the reference architecture that is represented with the defined hypotheses have been perceived satisfied by the provision of a service-oriented rural business collaboration platform that follows the reference architecture of SOBC for the rural business ecosystem.

6.2. Contributions

Previous research has provided insight that one of the promising approaches to tackle the problem of rural-to-urban migration is to develop rural economy and potentials by making the rural areas smarter through the provision of SOA-based collaborative service platform (Cunha et al., 2020; Mukti, 2019; Zavratnik et al., 2018). Multiple prior research has been conducted in this field of study to identify a set of different aspects of rural development and the strategy to develop ICT for rural areas (Sari et al., 2018), or to explore the principle components underlying a smart village conceptual model (Mishbah et al., 2018). However, rarely have been identified to propose a reference architecture that constitutes the basis towards an SOA-based collaboration between the public-private sector for a rural business ecosystem, as well as the one that facilitates the decision making in the design process of a rural business collaboration platform for a rural business ecosystem.

Given this reality, the practical contribution of this research is that the artifact delivered in this research, which is the reference architecture along with the working prototype, serves as a guideline or baseline model that can be used by researchers or practitioners in designing a business collaboration platform for a rural business ecosystem that follows the principles of SOA. This is especially true when the concern of the interested practitioners is about which business functions that a collaboration platform should support if this typical platform is to be provisioned for a rural business ecosystem, given that the desired goal of their initiative is aligned with the goals defined in this reference architecture. This statement is illustrated by the implementation of the proposed architecture to the case of West Java Digital Province since the local government has initiated the "smart village" initiative, which its desired goal and application context matches the defined goal and intended application context of the referenced architecture proposed in this research. Additionally, putting this statement into a theoretical perspective, this research also presents a method to represent a collaboration between interested parties based on SOA principles into EA principles using ArchiMate, which provides an integrated view towards motivation, business, application, and technology-related architectural layers.

6.3. Limitations and Future Research

A number of limitations that generate directions towards future research have been identified from this research. The first limitation is in regards to the limited number of respondents who participated in the validation of the architecture. This limitation leads to the limited opinion gathered from the perspective of the rural businesses towards the proposed architecture and the working prototype. The expected opinion from their perspective in regards to the proposed reference architecture in this matter is specifically important to the improvement of the proposed business processes that they will carry out if this architecture is going to be implemented in a real-world situation. Additional considerations based on their perspective will also determine how easy for them to shift to this offline-to-online business environment. In regards to the respondents who have participated, due to their tight schedule to participate in this validation research, most of the respondents eventually could not elaborate all of their opinions on some parts of the interview questions.

Furthermore, the limitation on the time that this research can be carried out has also determined the scope of this research in delivering the artifact. This is related to the limitation of business functions being proposed in the reference architecture of an SOBC platform for a rural business ecosystem, such as the lack of elaboration on the procurement module and the warehouse management module for example. The reason for this is that the urgency of these 2 modules to be provisioned for a rural business ecosystem was not identified to address the entry barrier faced by the rural businesses. However, these 2 modules have been identified their existence in the general reference architecture of an SOBC platform in Chapter 2 and at the same time are regarded by the validation respondents to be essential to be taken into consideration. In this regard, a future iteration to oversee the provision of these 2 modules should be considered. Moreover, this scope limitation is also correlated with the constraint on the possibility of answering sensitivity questions that explore the potentially different effects when the same artifact is implemented in different contexts (R. J. Wieringa, 2014). In the context of a rural business ecosystem, this sensitivity question could then explore the possible generated effects if the same reference architecture is implemented in a different province or different country with different culture and societal priorities.

Lastly, the last limitation identified in this research is related to the long-term impact that this proposed reference architecture of an SOBC platform can bring to the rural business ecosystem. Even though this research has validated the level of perceived satisfaction by the respondents that the architecture will bring benefits in the form of lowering a rural business ecosystem entry barrier to a digital business ecosystem, the role of this reference architecture in increasing the rural region economic welfare has not been much elaborated yet. As Mukti et al. (2020) have stated that an improvement in innovativeness and competitiveness of rural business ecosystem is essential in raising the perceived rural economic welfare, and the fact that longer-term research should be carried out to properly measure the said improvement, the next two questions that emerged for future research are formulated as:

- *What are the effects that this reference architecture of a service-oriented business collaboration platform will produce in a long-term implementation?*
- *How effective can this reference architecture of service-oriented business collaboration platform stimulate competitiveness, innovativeness, and entrepreneurship in rural businesses ecosystem?*

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Appendices

Appendix A. Interview Transcripts

A.1. Executive Director of West Java Digital Service (JDS)

Interview Date: Thursday, 11 March 2021				
No.	**Questions**	**Score**	**Positive Opinion**	**Negative Opinion**
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	4	(Not Available)	(Not Available)
2	To what extent is the platform architecture expected positively contribute to make rural services provision efficient?	4	- It is yet to be seen in the real-scenario implementation. However, while it is true that a government-initiated program will be welcomed by the rural businesses, it is also envisioned that this kind of initiative will less likely be sustainable if the operation of the offered services is going to be maintained by the government. In this case, the partnership with 3rd party platforms is a favorable approach.	(Not Available)
3	To what extent is the platform architecture expected positively contribute to	5	- Potentially need to consider warehouse or stock management feature to form as a	- How can this platform be promoted to be used by rural businesses? Socialization and

	empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?		complete solution. However, it can also be a whole module/application.	training by the government, or collaboration with another 3rd party?
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	5	- This sales module is perceived as a helpful solution to increase product promotion and sales channel for rural businesses, even though the current initiative is to drive the digitization of rural offerings to at least a single marketplace platform at the moment - A positive aspect is, through this platform, the government will be able to gather data regarding rural product/service transactions, which can lead to enabling demand forecasting. E.g. from the aggregated gathered transaction data, a certain type of crop is in high demand so the farmer can adjust their production volume and timing accordingly.	- In a real-world scenario, needs extra attention to the diversity of data format & structures in respect to having a centralized platform - Should also define the operating model, establish administrator for fulfillment center and quality control, how to manage customer chats comments and complaints, how to maintain a sustainable business model, etc - Also needs to consider if the transaction will be directed to the partnered marketplace, then what purpose does the product catalog in the rural platform serve? The strategic aspect for it will be better to be defined too
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	4	- Since the platform will be gathering the rural businesses sales transactions data, rural businesses access' to funding applications can be further improved, due to the improved credit score assessment. - This initiative can be a positive approach due to the fact that the rural platform, where the funding application is registered, is monitored by the government and the	- Same problem as sales module, how to facilitate the diverse data format and business processes later in the real-world scenario - As well as the business process for credit risk assessment will be more complex in a real-world scenario

			rural businesses will have a higher drive to pay off the lending, or potentially the government can also support financially the vital businesses.	
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	4	- Tourism content promotion, on the other hand, is perceived to be interesting even though the strategic and operational model should also be carefully planned. E.g. government agents (potentially from the creative and tourism sector) generate the seed/initial contents of tourism highlights in a rural region, then this rural platform feeds this seed contents to vloggers or tourists forums to invite them to contribute to generating reviews of the tourist spots - Subsequent to generating content or information regarding these rural tourism spots, these contents can refer or be referred to the relevant products and services offered in the surrounding area of the highlighted tourism spot, enabling cross-selling for rural businesses.	- For tourism service promotion, there is a potential that the 3rd party platform for tourism in the market right now is currently having a less ready open API compared to the products marketplace

A.2. Head of implementation of West Java Digital Service Division (JDS)

Interview Date: Friday, 12 March 2021				
No.	**Questions**	**Score**	**Positive Opinion**	**Negative Opinion**
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	5	(Not Available)	- This goal of (product or business entities) digitization also needs to consider how to bridge the gap between the capability of the provided IT services with the minimum level of digital literacy currently exist in the rural region. - However, this situation is planned to be tackled by arranging a rural community service and rural business development program for bachelor interns in order to induce knowledge transfer from the higher educated society to these rural businesses, which in turn opens up a new business model and development opportunities.
2	To what extent is the platform architecture expected positively contribute to make rural services provision efficient?	5	- Perceived to enable product (the platform) launch quicker than building the whole platform with all functionalities and capabilities from scratch, especially such as right now when the government's (human and capital) resources are mostly occupied for the COVID-19 pandemic.	- In a real-world situation, also needs to consider the mechanism and the roadmap to implement the collaboration and integration with the 3rd party platform providers, either in the perspective of application or business layer. (In ArchiMate, this translates to the Implementation and Migration layer)
3	To what extent is the platform architecture expected positively	4	(Not Available)	(Not Available)

	contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?			
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	5	- This sales order part of the architecture is aligned with the current priority of the Digital Village program, which also consists of not creating a new marketplace but creating a platform that can integrate rural businesses with the existing leading marketplaces. - This initiative is also perceived to be the approach to lower the rate of urbanization and increase the willingness of the local population to develop local businesses or attract entrepreneurs to develop businesses in the rural region.	(Not Available)
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	4	(Not Available)	(Not Available)
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	4	(Not Available)	(Not Available)

A.3. A representative from the lead of the West Java Rural Development Program

Interview Date: Thursday, 11 March 2021				
No.	**Questions**	**Score**	**Positive Opinion**	**Negative Opinion**
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	4	Currently, a lot of rural businesses haven't been supported by ICT. Through this platform, the required digitization in order for rural businesses offering to be discoverable by the market can be facilitated	Apart from technology penetration, the issue of ICT support limitation is also caused by the lack of knowledge of these rural businesses on using ICT to support their business.
2	To what extent is the platform architecture expected positively contribute to make rural services provision efficient?	4	(Not Available)	(Not Available)
3	To what extent is the platform architecture expected positively contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?	4	(Not Available)	(Not Available)
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	4	There is a notable issue related to the lack of market access. This issue is related to the digitization issue, where rural business offerings are hardly discoverable by potential customers. Through this platform, with the help of a fulfillment center and consistent training,	(Not Available)

			these rural businesses will gain an improvement in market access	
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	4	In order for the rural businesses to expand, they often need support in financing. It is common to receive funding from the government; however, the government cannot fund all of these rural businesses. Banks often come as the alternative. However, mostly, smaller businesses cannot appeal to banks due to their un-ability to provide proof of their business performance. By providing access to the partnered 3rd party funding platform for these rural businesses and sharing their business performance/sales transactions, rural businesses will have the chance to appeal to potential investors.	(Not Available)
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	5	Overall, looking forward to the possibility to integrate content /information regarding rural highlights into the tourism-related platform. In the case of West Java, there have been identified 2 types of villages by the government initiative related to the tourism sector: - Village Tour A village that has tourism spots (natural or historical site) - Tourism Village	(Not Available)

			A village that is developed and promoted to focus on the tourism sector (a number of resorts and crafts markets identified in addition to having natural, outdoor activities or historical site), which is currently made up roughly 20% of the population of all registered rural businesses in West Java Due to this fact, the collaboration initiative between this rural platform with 3rd party tourism platform will be an advantage both by the rural businesses, as well as the government in promoting these Tourism Villages	

A.4. A representative from the 3rd party lending service provider

Interview Date: Saturday, 13 March 2021				
No.	**Questions**	**Score**	**Positive Opinion**	**Negative Opinion**
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	4	(Not Available)	(Not Available)
2	To what extent is the platform architecture expected positively	5	- The collaboration has the potential to bring a positive impression to the 3rd party	(Not Available)

	contribute to make rural services provision efficient?		service provider, since in their perspective this collaboration with the rural platform may bring an additional GMV source - Gross merchandise value (GMV) is the total value of merchandise sold over a given period of time through a customer-to-customer (C2C) exchange site	
3	To what extent is the platform architecture expected positively contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?	4	- Mostly the consumers/buyers are spread out across multiple marketplaces, due to the diverse targeted market segmentation. Therefore, sellers are also demanded to approach their target consumers across multiple marketplaces as well nowadays. - In addition, these omnichannel marketplace management platforms are currently also in high demand in the industry due to this fact.	- Needs to put attention on the issue of "redundancies" in order management and "inconsistencies" in stock management, this is especially important for the production environment later.
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	4	(Not Available)	(Not Available)
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	5	- It is the current practice/business model in the lending/financing industry. A bank needs to channel their credit funds, but they need the means to assess their lenders' credit risk. - By acquiring and offering sales/business performance data of the rural businesses	(Not Available)

			to the lending platform, a better credit risk assessment is realized	
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	3	(Not Available)	It will be beneficial if in this tourism promotion, comments and testimonies from tourists can be facilitated since these are also the essential information needed by the tourist spots to attract potential tourist

A.5. A representative from the 3rd party (ex-) marketplace and lending service provider

Interview Date: Friday, 5 March 2021				
No.	**Questions**	**Score**	**Positive Opinion**	**Negative Opinion**
1	To what extent is the platform architecture expected positively contribute to improving information exchange capability in a rural business ecosystem?	4	- Perceived the architecture and prototype as a pipeline to highlight and promote the potential businesses and products/services in rural to the demands in the consumer side, where the existing pipeline has not yet optimal to make these businesses visible/discoverable.	(Not Available)
2	To what extent is the platform architecture expected positively contribute to make rural services provision efficient?	4	- By enabling modularity of the rural platform in relation to establishing a partnership with the 3rd party marketplaces, it is perceived as enabling an efficient approach to improve market access as well as strengthening the public-private business collaboration ecosystem	Keeping in mind the people-business-technology successful key elements, the people aspect should be further examined: - Making sure that all involved stakeholders (platform provider, government agents, and rural businesses) are ready

				- Making sure that the engagement of these IT services with the rural businesses and the transition from offline-to-online business will run smoothly
3	To what extent is the platform architecture expected positively contribute to empower diverse economic potential in rural areas (e.g. creative products, amenities, agriculture)?	5	(Not Available)	(Not Available)
4	To what extent is the platform architecture expected positively contribute to improving rural market access?	5	- (Similar to the concern of digitization above) - In terms of increasing the level of promotion, the rural platform provider (in this case government), may subsidize the synchronized rural businesses' user account in the 3rd party marketplace to be upgraded into the paid account in order to gain the highlighted position in the marketplace platform.	(Not Available)
5	To what extent is the platform architecture expected positively contribute to improving access to funding sources?	5	- In relation to the ability of the rural platform to capture the transaction performance of rural businesses and sharing it with the partnered funding platform, most lending bodies (p2p lending, banks) are currently interested in additional data that are scarcely available before. - There are 2 types of financial data being demanded by the industry at the moment.	- Should also consider the approach in enabling funding application, rather than filling out the required details in the rural platform and then send them to the funding platform, the whole process of funding application can also be handled by the funding platform itself leaving the rural platform as only a gateway. This is to simplify the business/application process

			In addition to the formal data, mostly, alternative data is the complementary data that they needed to improve their risk management process. Alternative data is all digital activities that are recorded by or from any (digital/physical) platforms. Through this rural platform, the lending platform is expecting that the unique digital activities of rural businesses are to be captured.	when multiple funding platforms are partnered, similar to the sales transaction.
6	To what extent is the platform architecture expected positively contribute to improving the promotion of rural attractions?	5	(Not Available)	(Not Available)