Architecting a service-oriented rural platform

Improving rural economic climate through participation in the digital business ecosystem

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Abstract—Improving the rural economic climate to narrow the rural-urban economic gap is necessary in order to address the problematic urbanization phenomenon in many developing countries. To this end, the participation of rural communities in the digital business ecosystem is being viewed as a promising approach. However, there are high barriers that hinder rural communities from participating in the digital business ecosystem. The barriers are mainly due to the low digital readiness of the rural communities, the limited government capability, and the limited third-party involvement. With an aim to lower these barriers, our paper proposes the architectural specification of a digital platform based on a service-oriented architecture, where the provisioning of digital business services for rural communities is realized through a collaboration between the government and third-party service providers. The proposed architecture has been instantiated by means of a prototype and validated by a panel of experts from the rural areas of West Java, Indonesia.

Keywords—rural development, rural smartness, service-oriented architecture, digital business ecosystem, enterprise architecture, ArchiMate.

I. INTRODUCTION

In the last 50 years, the economic growth in most of the developing countries has been rapidly increasing. Their current average GDP has increased more than 50 times since 1970 [1]. Large metropolitan areas have emerged in these countries as their economic engines, dominating the world's mega-cities [2].

However, the agglomeration of economic activities in the cities, despite increasing the countries' economic productivity, has an important downside. It creates a wide economic gap between urban and rural areas that motivates people to engage in rural-urban migration at a rapid pace [3]. Urban population in developing countries jumped from 17.7% in 1950 to almost 60% by the year 2030, where rural-urban migration is the major cause [3, 4].

Urbanization at this rapid pace puts the majority of developing countries in a problematic position. First, the under-sized capacity of their urban infrastructures has led to various urban problems, to name a few: traffic congestion, energy crisis, and degradation of environmental quality [3]. Second, because a large proportion of rural-urban migrants lack the skills necessary for well-paid jobs in the cities, the migrants typically end up in low-wage jobs, which traps them into poverty [3]. Third, the economic attractiveness of the cities that pulled most people at productive age have made rural areas lack the talent needed to fuel their economic engine [5]. This, in turn, makes alleviation of poverty, which mostly occurs in rural areas [6], more difficult.

To slow down the rural-urban migration to a manageable pace, the trigger, i.e., the rural-urban economic gap, should be narrowed. In this regard, recent studies pointed out that the improvement of rural economic climate could be achieved by enabling rural communities to participate in a digital business ecosystem (DBE): an environment of interacting organizations and individuals that co-create values through shared digital platforms [7-9]. In practice, the leading sectors of DBE are online commerce, online media, online travel, and online financial services [10].

In many developing countries, DBEs are growing rapidly. Countries in Southeast Asia are an example of this phenomenon. As a region comprised mostly of developing countries, Southeast Asia's internet economy has tripled from $32 billion in 2015 to $100 billion in 2019 [11]. Moreover, the value of their internet economy is projected to exceed 8% of the GDP by 2025, closing the gap with a developed market like the United States, where the internet economy accounted for 6.5% of the GDP in 2016 [11]. This phenomenon shows that DBEs are a promising vehicle for economic growth.

However, despite its promising economic potential, rural communities are still marginalized in the current DBE as it is highly urban-oriented [12]. For example, e-tailing sales volume from rural sellers in Indonesia only accounted for 0.5% ($ 0.024 billion compared to $ 5 billion total country’s e-tailing sales) in 2017 [13], and 75% of total e-commerce sales in Vietnam were generated only from its two big cities: Hanoi and Ho Chi Minh City [12].

We argue the reasons why the rural communities were left behind are the following. First, rural communities have insufficient IT infrastructures [14] and limited digital literacy.
that hinder them from using the services provided in a DBE. Second, the government, as the party that is responsible for rural development, has a strict financial budget [16] that limits its capacity to facilitate digital services for rural communities. Lastly, facilitating the rural communities to participate in a DBE is not economically attractive for service providers from the private sector [17]. This is due to rural citizens’ low purchasing power and high investment to provide the necessary IT infrastructure and to improve their digital literacy [6, 17].

II. PREVIOUS STUDIES AND RESEARCH QUESTION

Previous studies have discussed three approaches to improve the rural economic climate through the participation of rural communities in a DBE: top-down, community-driven, and combined approach [18]. In a top-down approach, the government acts as the main actor that drives the establishment of a DBE for the rural community, including community development, and digital platform development and operation. This approach is found to be effective when the government has a strong commitment and large capital investment. An example of this is the information network village (INVIL) program that is driven by the South Korean government [19]. However, this approach requires a large amount of government investment [19], it is difficult to be applied in low-middle income countries.

On the other hand, in the community-driven approach, different actors (e.g. 3rd party marketplace companies, rural businesses, community leaders, and institutional supporters) collectively drive and self-organize themselves to establish the DBE [18, 20]. Since the actors are forming the ecosystem by themselves without enforcement from external parties, this approach is considered to be effective in establishing a sustainable DBE [20]. However, this approach takes time and does not always evolve into the desired state, especially when the rural areas lack the necessary readiness factors, such as low digital literacy and a lack of proper IT infrastructures [18].

To address the challenges of the first two approaches, Li, et al. [18] proposed the combined approach: the programs to improve the rural economy are led and regulated by the government, while the DBE is established through cooperation with a third-party digital service provider. As Li, et al. [18] examined from the case study in China, to alleviate poverty in rural areas, the government collaborated with Alibaba, the dominant online marketplace provider in China. In the collaboration, the government proactively provided the required infrastructures (e.g., IT and transportation) and nurtured the rural community to be ready for the DBE, whereas Alibaba provided their digital platform as the official channel for the rural communities to participate in the DBE.

We argue that the aforementioned combined approach works well in an environment where a single player dominates the DBE and has strong legitimate support from the government, as in the case of Alibaba [21, 22]. Therefore, although the approach is successful in China, it could be challenging to apply the same approach in an environment dominated by multiple players: where more than one player holds a significant market share in the DBE. This type of environment can be found, for example, in Southeast Asian countries, India, and Brazil [11, 23, 24]. In this type of environment, it is unlikely that the government of the country can only involve one service provider, as such an agreement can threaten the healthy market competition which is essential for long-term economic vitality [25, 26].

Given the above challenges, to ensure the combined approach can be implemented in an environment dominated by multiple players, we propose the diffusion of a digital platform based on a service-oriented architecture (SOA). The reason for this argumentation is because such a platform enables these multiple parties to collaborate for mutual benefits [27]. Therefore, we formulated the following research question:

How to design a SOA-based digital platform to improve the rural economic climate through participation in a DBE?

Previous studies have already discussed the utilization of SOA as the basis for developing digital platforms aimed at improving the rural economy. However, these studies are mainly aimed at (1) improving intra-connectivity within the rural environment (e.g.: to optimize rural produce [28] or to improve collaboration among rural communities [29]), and (2) streamlining the flow of information in one particular rural economic area, such as agriculture [30, 31]. A study that specifically focuses on the design of a SOA-based digital platform aimed at improving inter-connectivity of rural communities to their external environment (e.g., market and funding sources) through a DBE and taking into account the diverse rural economic potential is still missing. Therefore, this paper contributes to filling this gap by proposing the architecture of a service-oriented rural platform (SORP) to improve the rural economic climate through rural communities’ participation in a DBE.

The proposed architecture was developed following the design science research methodology [32], which has also influenced the structure of the remainder of this paper. Section III discusses the requirement analysis consisting of problem identification and solution definition. Section IV presents the architecture of SORP. Section V describes the development of the first iteration of a prototype that demonstrates the feasibility of the proposed SORP architecture. Section VI discusses the architecture evaluation by domain experts within the context of a case study in the rural areas of West Java, Indonesia. We selected this region because the region is confronted with serious urbanization problems caused by rural-urban migration, and because the regional government has been implementing initiatives towards the diffusion of SORP. Finally, section VII provides the conclusion and gives recommendations for future work.

III. REQUIREMENTS ANALYSIS

There are two sources that we used to define the requirements for the SORP architecture. First, a systematic literature review (SLR) that explores the challenges of diffusing digital technology in rural areas [33]. Second, the interviews that we carried out with the experts from the West Java province in Indonesia. Information from these sources was then analyzed using the technology-organization-
environment (TOE) framework that is widely used for studying the adoption of technology innovation in various contexts [34]. The requirement analysis resulted in the motivation model shown in Figure 1. The model was depicted using the motivation elements of the ArchiMate modeling language [35] that captures the problem identification (indicated by ArchiMate’s assessment elements) and the solution definition (indicated by the requirement and goal elements). The motivation model of SORP suggests that six architecture requirements need to be fulfilled to improve the rural economic climate through participation in a DBE. The requirements are presented below.

1) **The platform shall facilitate digitization to improve the information exchange capability in a rural business ecosystem.** From a technological perspective, rural communities have insufficient IT infrastructure that limits them from utilizing digital services [14]. This limitation results in difficulties with quickly exchanging information about their resources, products, or services for economic value [36]. Therefore, to improve the economic climate in rural areas, it is fundamental for the SORP to facilitate digitization to enable an easier information exchange process.

2) **The platform shall facilitate collaboration with third-party service providers to efficiently provide digital business services for the rural communities.** Due to its remote location and limited infrastructure, initiatives towards rural development are not attractive for the private sector, and thus, have to be driven by the government [19, 37]. However, the government has a strict financial budget [16] that limits its capacity to facilitate digital business services for rural communities.

To efficiently facilitate digital business services for rural communities, the government should collaborate with third-party service providers [18]. In this way, the government could focus its effort on digitizing the rural business ecosystem and nurture the rural communities to be ready for DBE. On the other hand, third-party service providers can engage rural communities to use their services without the burden of ensuring their digital readiness. Therefore, the SORP should enable this collaboration.

3) **The platform shall facilitate broader market access.** The specific geographic characteristics of rural areas are remoteness and limited connectivity to the economic centers that are concentrated in urban areas [17]. The immediate consequence of this is low accessibility to the market, which forces business ecosystems in rural areas to operate mostly locally, and leads to a stagnant economy [5]. Therefore, it is important for SORP to facilitate access to a broader market to stimulate rural economic growth.

4) **The platform shall facilitate market access specialization to empower the diverse economic potential**

A lot of economic potential is available in rural areas. Depending on the geographical location, local resources, and socio-economic situation, this potential can materialise in agriculture (e.g. crops and livestock), consumer goods (e.g. culinary products and crafts), or tourism (e.g. nature landscape, museums, culture, and event) [5]. Nevertheless, this potential could be turned into actual economic value only when the demand for these products and services exists. Therefore, to generate the demand, SORP should facilitate market-access specialization: tailoring access to the market based on the unique economic potential of a particular rural area.

5) **The platform shall facilitate access to funding sources.** Microbusinesses driven by entrepreneurs are the main actors in the rural economy [8]. They play a vital role as the innovation agents that transform rural resources into economic value, triggering economic activities and employment in rural areas [5]. However, the lack of available financing has been the bottleneck for rural entrepreneurs to start their businesses, and for the existing businesses to grow [38]. Therefore, the facilitation of access to funding sources through SORP is critical for fueling the economic engine in rural areas.

6) **The platform shall facilitate rural promotion to improve public awareness of rural attractions.** Besides selling local offerings to a broader market, attracting visitors to rural areas is equally important to stimulate agro-tourism and drive rural economic activities [39]. However, despite their rich potential, rural attractions are only of local significance and less popular than urban attractions [39]. One of the reasons is the lack of information about attractions in rural areas [7]. Therefore, to increase the outreach of such information, the SORP should facilitate the promotion of rural attractions through digital means.

IV. **Architecture**

Based on the identified key requirements, in this chapter, we propose the architecture for SORP. The proposed architecture aims to serve as a reference that can be used to guide the development of a SORP in a real setting. We design the architecture using the ArchiMate modeling language [35] to represent the interplay of concepts on the business, application, and technology layers.
We specify the architecture by means of four custom ArchiMate viewpoints that correspond with the requirements of SORP presented in section II. First, the **collaboration viewpoint** illustrates the interaction between roles involved in the SORP, corresponding with requirements 1 and 2. Second, the **sales application usage viewpoint** explains the usage of application components for the sales business process, corresponding to requirements 3 and 4. Third, the **funding application usage viewpoint** explains the usage of application components for the funding business process, corresponding with requirement 5. Finally, the **promotion application usage viewpoint** explains the usage of application components for the promotion business process, corresponding to requirement 6.

### A. Collaboration viewpoint

The requirement analysis suggests that the provisioning of digital business services for the rural community should be realized through collaboration. As shown in Figure 2, aligned with the SOA principles, the collaboration involves three roles, namely, service requester, service broker, and service provider. The service requester aims to facilitate the digital business services concerning the functionality required by the rural communities, namely, sales (market access), funding, and promotion. In realizing this functionality, the service requester consumes the services offered by the service provider. Meanwhile, the service broker plays the role of orchestrating the collaboration. Further explanation of this collaboration is described in more detail in the subsequent viewpoints.

Since in general rural development initiatives are the task of the government as emphasized in Zavrbatnik, et al. [37], we argue that the government should drive the establishment of the service requester and the service broker. This way, the third-party service provider can offer rural communities their services without the burden of ensuring their digital readiness. Hence, the government can efficiently provide rural communities access to DBE.

### B. Sales application usage viewpoint

The sales application usage viewpoint, shown in Figure 3, zooms into the interplay of application components (among the SORP roles) supporting the sales business processes. In this viewpoint, the marketplace provider plays the role of the service provider. Based on the requirement analysis, there are three types of marketplaces that are relevant for the rural economic potentials: 1) retail marketplace that sells rural consumer goods, 2) agribusiness marketplace that sells rural crops and livestock, and 3) travel marketplace that facilitates the consumer to book amenity services.

The business processes provided in this viewpoint are based on the common processes of B2C e-commerce [40]. It starts with the product registration, where the rural business unit adds the product's information in the rural platform's e-commerce module. The product's information is then orchestrated by the Enterprise Service Bus (ESB), to be routed to the relevant marketplaces. Important to note, the product's information is routed to specific marketplaces based on the product's nature. For example, consumer goods products will be routed to the retail marketplace. On the other hand, amenity services will be routed to travel marketplaces. This way, the rural products are connected to their relevant market.

95
After a product is registered, consumers can discover the product through two interfaces: the rural product catalogue provided by the service requester, and the marketplace application provided by the marketplace provider. This product discovery is then followed up by an order placement and payment process facilitated by the marketplace application.

To process the placed order, the order information stored in the marketplace platform can be transmitted to, or requested by, the rural platform through the orchestration service provided by the ESB. Then, through the rural
platform’s e-commerce module, the rural business unit can modify the delivery status when delivering the product to the consumer. Meanwhile, the consumer can monitor the product delivery from the marketplace application.

C. Funding application usage viewpoint

Due to their remoteness, businesses in rural areas have limited access to loans from financial institutions, like banks. As a consequence, it is difficult for entrepreneurs and SMEs in rural areas to grow. To address this issue, providing funding for businesses in rural areas through marketplace lending is seen as a promising alternative [38].

Marketplace lending refers to loan fulfilment activities facilitated by a platform that matches borrowers with lenders [41]. A Marketplace lending platform enables a large number of people to invest a relatively small amount of money in investment projects that match their interests. Since the marketplace lending platform enables more people to contribute as investors (e.g., through peer-to-peer lending), the likelihood of rural businesses getting funded is expected to increase. Therefore, to improve rural businesses' access to financial resources, we propose that the marketplace lending provider plays the role of the service provider.

Figure 4 shows the funding application usage viewpoint that zooms in the interplay between the SORP application components in supporting the funding business processes. The business processes provided in this viewpoint are derived from the common processes of marketplace lending [41, 42].
The business process starts with a loan request registration, where the rural business unit, as the borrower, registers the necessary information required by the marketplace lending provider. This process is done through the funding request interface provided in the rural platform. The ESB then routes information of the loan request to the marketplace lending for the loan underwriting process. To support the underwriting process, the rural platform provides an API that enables marketplace lending to access the rural business unit’s transaction data as additional information for the evaluation.

When the underwriting process is positive, the requested loan is then published as a crowdfunding campaign in the marketplace lending application, where the consumer (citizens) can take the role of a lender to fund the loan. During the campaign, the borrower is able to monitor the campaign progress through the rural platform. As soon as the campaign is settled, the borrower will receive the loan and then re-pay the loan according to the agreed terms with the marketplace lending provider.

**D. Promotion application usage viewpoint**

Figure 5 depicts a viewpoint that specifies how the information about rural attractions can be conveyed to broader audiences. Since the internet has become the primary gateway for travelers [43], in this viewpoint, the tourism portal provider, which offers online information on the tourism destinations, plays the role of the service provider.

The rural content manager, a sub-role of the service requester, starts the process by publishing the content on rural attractions in the rural platform’s tourism module. The ESB then routes the information to the tourism portal(s) connected to SORP. By having the information available in the tourism portal, it is expected that the travelers can find rural attractions, either through the search engine results, or through directly visiting the tourism portal.

**V. Prototype Development**

To demonstrate how SORP fulfills the defined requirements, we instantiated the SORP architecture by means of a prototype. The prototype implements all of the SORP application usage viewpoints presented in section IV.

To demonstrate the application usage viewpoints, we developed 5 prototype applications and an ESB configuration. The prototype applications are the following: 1) rural platform - the digital platform managed by the service requester (see Figure 6.a), 2) retail marketplace - a B2C marketplace specialized in selling consumer goods (see Figure 6.b), 3) agribusiness marketplace - a B2C marketplace specialized in selling crops and livestock (see Figure 6.c), 4) travel marketplace - a B2C marketplace specialized in selling amenities service and a tourism portal (see Figure 6.d), and 5) marketplace lending that emulates the crowdfunding process (see Figure 6.e). Meanwhile, the ESB configuration consists of message routing, message transformation, and service registry (see Figure 6.f).

Figure 7 shows the technology stack we used in the prototype. We used Mendix as the development platform for the prototype applications and WSO2 Enterprise Integrator (WSO EI) as the ESB. We decided to use Mendix because it enables the rapid development of prototype applications using a low-code approach [44]. Moreover, Mendix provides web-services technology such as REST API that facilitates the inter-application communication required by the SORP architecture. On the other hand, we chose WSO2 EI because it provides diagrammatic tools to easily set up the necessary ESB configurations required by the prototype, and is available as free open-source software.

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1 Information on access to the prototype can be found in https://github.com/danniarrareza/Service-Oriented-Rural-Platform/prototype-information
VI. VALIDATION

We used the expert opinion method to validate whether the proposed SORP architecture fulfills the requirements defined in section II. In this method, the design artifact is submitted to a panel of experts that evaluate how such an artifact addresses the problem context and predicts the effects [45]. The panel of experts that participated in this study are representatives from rural areas of the West Java province in Indonesia.

West Java is the most populated province in Indonesia. It has more than 48 million people inhabiting 27 cities and more than 5000 villages [46]. In the pursuit of better economic opportunities, most of its rural inhabitants have been migrating to urban areas. Currently, more than 70% of the region’s population is living in its urban areas. Although this urbanization phenomenon contributes to higher economic growth than the national average (5.58%, compared to 5.17%) [46], it made the urban areas extremely dense and confronted with various problems. For example, traffic congestion, unemployment, scarcity of housing, and degradation of environmental quality. Therefore, to address this urbanization problem, the provincial government has been implementing initiatives to improve the economic welfare of its rural citizens through IT innovation, including the diffusion of SORP.

Six experts representing different perspectives participated in the expert panel: The head of the ICT agency of West Java, the head of implementation of the West Java Digital Service, and the IT advisor to the provincial government provided feedback from the perspective of the government. Representatives from retail marketplace providers and marketplace lending providers provided input from the service provider's perspective. Lastly, a representative from the government's village agents provided feedback from the perspective of the rural communities.

Figure 6. Screenshot of SORP prototype: (a) product administration in rural platform, (b) retail marketplace platform, (c) agribusiness marketplace platform, (d) travel marketplace and tourism portal, (e) marketplace lending platform, (f) ESB configuration

Figure 7. Prototype architecture
A. Validation scenario

Validation by expert opinion only works when the experts understand the artifact being evaluated [45]. Therefore, the experts need to have a sufficient understanding of the proposed architecture. To do this, we explained all the viewpoints presented in section IV, demonstrated the prototype, and gave the experts the opportunity to use the prototype.

Based on the presentation and the prototype demonstration, we then asked for two types of feedback from the experts. First, we assessed their perception of whether the SORP architecture satisfies the defined requirements presented in section II. Second, we explored in a qualitative manner their opinions on the impact of implementing such an architecture in the rural areas of West Java.

For the first part, we used close-ended questions that correspond with each requirement. The questions used a 5-point Likert scale, where a score of 1 indicated that a certain requirement is not met, and a score of 5 indicates that the requirement is fully implemented. On the other hand, for the qualitative research, we used open-ended questions concerning: 1) the positive effects of the proposed architecture in fulfilling the requirements, 2) readiness factors that need to be fulfilled to ensure the feasibility of the requirements, and 3) components that were missing in the proposed architecture that can support the fulfillment of the requirements.

B. Validation results

Table 1 shows the scores of the experts’ perceptions on whether the SORP architecture satisfies the defined requirements. It can be seen from the table that all of the average perception scores (avg) are above 4, indicating that the experts are mostly satisfied with the extent to which the proposed architecture is covering the original functional requirements. In addition, standard deviations (std) of all perception scores are less than 1, suggesting a strong agreement among the experts.

To justify the perception scores, in the remainder of this section, we provide an individual analysis on the fulfillment of each requirement by the proposed architecture. The discussion is based on the answers to the open-ended questions we gathered from experts.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Avg</th>
<th>Std</th>
</tr>
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<tbody>
<tr>
<td>Facilitate digitization to improve information exchange capability in rural business ecosystem</td>
<td>4.2</td>
<td>0.41</td>
</tr>
<tr>
<td>Facilitate collaboration with the third-party service providers to efficiently provide digital business services for the rural communities</td>
<td>4.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Facilitate broader market access</td>
<td>4.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Facilitate market access specialization to empower the diverse economic potentials</td>
<td>4.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Facilitate access to funding sources</td>
<td>4.3</td>
<td>0.52</td>
</tr>
<tr>
<td>Facilitate rural promotion to improve public awareness of rural attractions</td>
<td>4.2</td>
<td>0.75</td>
</tr>
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Requirement 1: facilitate digitization to improve the information exchange capability of the rural business ecosystem.

The experts unanimously agree that the digitization service presented in the proposed architecture has a strong positive impact on improving the information exchange capability. Particularly, one of the experts highlighted that digitization could act as the pipeline that enables rural offerings discoverable in DBE.

Furthermore, the experts suggest that digitization will only be successful when SORP is being used by rural communities. Therefore, it is important to ensure digital readiness in rural areas, namely, IT infrastructure (i.e., internet access and digital devices) and digital literacy (i.e., operational capability and willingness to use). They suggest this digital readiness is prepared at least at the level of rural business units. In our case study, these rural business units are mainly village-owned enterprises, namely rural businesses managed by the village government. Rural microbusinesses could sell their products through these rural business units and focus their efforts on the creation of the products instead of facing difficulties in selling them online.

Requirement 2: facilitate collaboration with third-party service providers to efficiently provide digital business services for rural communities.

The experts suggested that the third-party collaboration enabled by the proposed architecture is the efficient approach to bring the rural communities to participate in DBE. They argued the collaborative approach benefits the government and third-party service providers. For the government, which plays the role of the service requester and the service broker, the proposed architecture is perceived to be more efficient than developing and managing all the necessary services from scratch. This approach enables the government to focus its effort on ensuring the rural community's digital readiness without huge investment to provide the full functionalities of the services. On the other hand, for the third-party service providers, this collaboration is expected to bring a broad range of rural products without the burden of ensuring the digital readiness of the rural communities.

To successfully implement this collaborative approach in a real setting, the experts unanimously mentioned that the engagement with the third-party service providers is the critical readiness factor that needs to be ensured. This readiness factor covers both business and technical aspects. For the business aspect, it is essential to formulate a business model that can add value to the service providers. Furthermore, it is also important to define a clear responsibility for each party involved in the collaboration. On the other hand, for the technical aspect, it is critical to ensure interoperability with the service providers. This interoperability readiness is concerned with the differences in application processes, data fields, message formats, and APIs used by the multiple service providers participated in SORP.

Requirement 3: facilitate broader market access.

The experts suggested that by implementing the proposed architecture, rural businesses could effectively reach a broader market through multiple marketplaces, while at the same time they can conveniently manage their products and orders on a single platform. Furthermore, the experts argued that the broader market access would lead to a higher demand for rural products, which would improve the rural economic climate.
This, in turn, is expected to encourage rural citizens to stay and work in the village instead of migrating to urban areas.

To successfully satisfy this requirement, the experts suggested that rural businesses’ ability to fulfill a higher demand is the key success factor. Since broader market access leads to increasing demand, to maintain the consumers’ trust in the rural products, it is important to ensure that the rural businesses are able to fulfill the demand timely and meet the expected quality.

Related to this readiness factor, the experts also pointed out that there is a component missing in the current architecture, namely, demand forecasting. Demand forecasting is an analytical function that helps rural businesses to make an accurate projection on customer demands based on historical data. Availability of demand forecasting is expected to help rural businesses define the accurate strategy to enter a new market and have a better plan to fulfill the increasing demand.

Requirement 4: facilitate access to specialized markets, to increase and exploit the diverse economic potential.

The experts highlighted that the fulfillment of this requirement is strongly relevant to the real situation in rural areas of West Java, where the economic potentials are very diverse. Aligned with the proposed architecture, the experts confirmed that the major economic potentials in the region can be grouped into three categories: retail products (i.e., culinary products and crafts), agribusiness products (i.e., crops and livestock), and tourism products (i.e., amenities, vacation rentals, and event).

To successfully satisfy this requirement in a real setting, the experts suggest similar readiness factors to requirement 3. In addition, one of the experts particularly emphasized that the rural digitization platform should be ready to handle data field differences across the supported product categories. For example, required data fields for retail products are different from tourism products.

Requirement 5: facilitate access to funding sources.

The experts argued that fulfillment of this requirement is strongly relevant to the current situation in a real setting, where rural businesses have limited funding access. Integration with the marketplace lending platforms, facilitated by the architecture, connects loans proposed by rural businesses to a large pool of individual investors. This, in turn, increases the likelihood of the requested loans getting funded.

On the other hand, the experts pointed out that the integration also benefits the marketplace lending providers. Accessibility to the rural businesses’ performance data allows the marketplace lending providers to have complementary data for the risk assessment process, resulting in a more accurate loan underwriting decision.

Despite their overall positive opinions, the experts suggested several aspects to improve the effectiveness of this funding service in a real setting. First, the funding request process could be simplified. The data entry process for the loan request could be done in the funding platform instead of in the rural digitization platform. This is due to differences in the required data fields and the loan request procedures among funding providers. Second, connectivity with the funding providers should not be limited to marketplace lending providers. The connectivity should also be possible for other types of funding providers, for example, banks and micro-credit providers.

Requirement 6: facilitate rural promotion to improve public awareness of rural attractions.

The experts pointed out that the facilitation of rural promotion is strongly relevant. Rural areas of West Java have rich attractions but have low visibility.

To effectively fulfill this requirement, the experts suggested preparing a well-defined strategy to provide massive, accurate, and rich content about rural attractions. One of the options could be by collaborating with tourism communities. Furthermore, the experts advised that the promotional content should be linked to the relevant products being sold in the sales module to accelerate rural economic growth.

VII. CONCLUSION AND FUTURE WORK

In this paper, we present the architecture of a service-oriented rural platform (SORP) that aims to improve the rural economic climate by enabling rural communities to participate in a DEB. The architecture design is based on the principles of SOA, where the provision of digital business services for rural communities is realized through collaboration between the government and third-party service providers.

The proposed architecture was validated by a panel of experts representing a case study from the rural areas of West Java, Indonesia. According to their opinions, it can be concluded that the proposed SORP architecture has a strong positive impact on lowering the barrier for rural communities to participate in a DEB. Thus, it is expected to improve the rural economic climate.

By mid-2021, the ICT Agency of West Java has been rolling out the initial phase of the SORP implementation where the architecture presented in the sales application usage viewpoint has been implemented and made available for limited users. In this phase, the SORP has managed to handle product synchronization with two dominant marketplace providers in Indonesia, namely, Tokopedia and Shopee.

Finally, this paper has several limitations that generate directions for future work. First, the experts who participated in our study were all from one region, representing the rural areas of West Java, Indonesia. Although their opinions are very likely to be relevant for other rural areas with similar a setting, validating results based on a single case study might be a threat to the generalizability of our findings. Therefore, future work should address sensitivity questions, as suggested by Wieringa [45], that research the expected impacts of SORP in different contexts.

Second, this paper only assessed the perceived impacts of SORP based on the experts’ opinions on the architecture design and the prototype. It is still unclear what will be the size of the SORP’s economic impact after its actual implementation. Thus, the next step would be to measure the actual impact following the development and implementation of SORP in West Java, which is currently in progress. For this, an additional monitoring component can be added to SORP, that would use transactional data collected through the
platform to estimate the volume of new business generated by the introduction of the platform. This approach would also have the advantage of being able to monitor real-time the platform diffusion and adoption process, and help the government identify the areas that need supplementary stimuli and specific interventions to speed up and steer this adoption process. This also brings us to the next frontier to future work. In this paper, we did not explain how to ensure that the rural business units, as the main target group of SORP, would be willing to use the rural platform as part of their economic activities. This limitation thus leaves room for future work to explore factors affecting adoption decisions and use behavior of SORP, for example, by employing relevant user acceptance theories, such as UTAUT [47].

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REFERENCES


[38] A. A. Eniola and H. Entebang, "SME Firm Financial-Innovation 


