Service Oriented Architecture Design using SOMA for Optimizing Public Satisfaction in Government Agency

Case Study: BPN – National Land Authority of Indonesia

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***Abstract*— Service oriented architecture (SOA) enables organizations to easily integrate systems, data, and business processes. Implementation of SOA solution in private sector is widely used and successfully proven to increase their profit. But there are different challenge in public sector which is not profit oriented and has different business model. In public sector, user satisfaction on government agencies is one of common indicator to measure quality of public service. This paper presents SOA solution for public sector using SOMA to conduct a service integration for optimizing public satisfaction. We also combined SWOT and Porter's Value Chain to support business modelling analysis. The result shows that there is a simplicity and feasibility for users to access the service after SOA integration, which improves user satisfaction.**

Keywords—Service Engineering, SOMA, Service Design, Service Oriented Architecture, Public Sector

I. INTRODUCTION

Service Oriented Architecture (SOA) aims to align the business process with the use of IT in a way that makes both more effective, so it is possible to integrate between several Information Systems in an organization [1], [2]. Due to the advances of Internet, e-government solutions based on SOA is recommended for transforming traditional government solutions that are already deployed to be more integrated [3]. It is because SOA can helps organizations, e.g. government agency, to develop a logic and data sharing among various software applications in different platform easily [4].

Performing information technology (IT) systems allignment using SOA to provide end-to-end enterprise integration and virtualized IT services is a critical step for organization [5]. The study on implementation and improvement of SOA solution in private sector is widely known and is easily measured [6]–[8], but has not been so extensive in public sector for optimizing public satisfaction.

In this research, we proposed online Renewal of Individual HGU Service (Hak Guna Usaha/Business Operation Rights) in BPN – National Land Authority of Indonesia. The SOA design concept in this case study will be implemented using Service-Oriented Modeling and Architecture (SOMA) methodology. The design is proposed to perform integration among several existing and proposed application system in different platform.

II. THEORETICAL BACKGROUND

A. Service Oriented Architecture (SOA)

SOA is usually defined as an architectural approach that helps to achieve loose coupling among interacting software agents [9], [10]. SOA supports software reuse and enables the ability of a software system to be customized, configured and adopted to meet particular requirements at both design and run-time [11]. By using SOA, an organization can increase current revenue, reduce business process cycles, and also reduce time and costs for systems integration [12].

B. Service Oriented Modelling and Architecture (SOMA)

SOMA is service-oriented method developed by IBM to support the latest software engineering best practices for building SOA-based solutions [13]. SOMA was proposed as a business-driven modeling and design method which provides in-depth guidance on how to move from the business models to the IT models required by SOA [9]. It also has been widely used in industrial projects and is widely known as the most prescriptive SOA methodology [2], [14], [15]. SOMA adopts such existing techniques and notation as: BPM, UML, BPEL, WSDL, WS-BPEL, which is useful to provide a clear design and analysis diagram [14].

C. Public Satisfaction in Government Agency

Citizens are usually skeptical towards the government in general terms, but often satisfied with specific services, in other words, they want more service delivery from the government [16]. High levels of public satisfaction in government agencies indicating better quality of public services and high quality performance of the agency itself [16]. This term is in line with one of the priority agenda of BPN that is to improve the quality of service by building public trust [17].

III. RESEARCH METHODOLOGY

In this research, we proposed the implementation of SOA design concept using SOMA methodology, because it covers all SOA analysis & design activities, and provides steps, activities, inputs and outputs description for each phase. SOMA consists of 7 phases as can be described in figure 1, which is detailed in 21 steps to construct a full SOA lifecycle.

There is an existing assets analysis step in identification phase, which is suitable for public sector (government agencies) to prepare SOA integration using existing sistems

and applications. We also combined SWOT and Porter's Value Chain to support business modelling analysis.

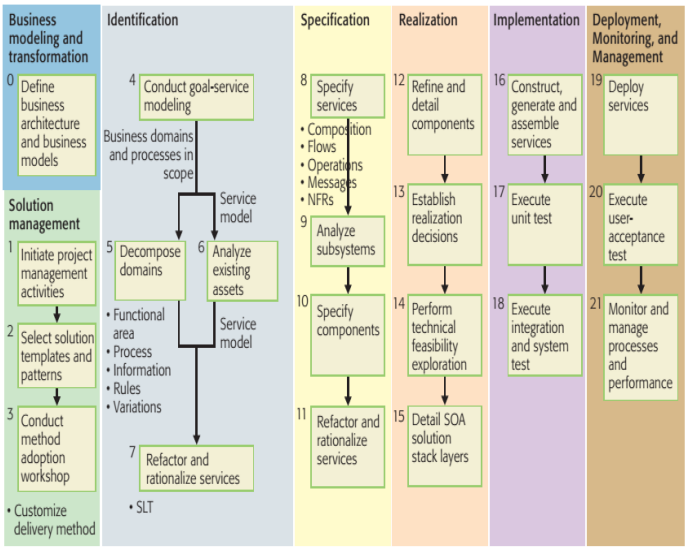

Fig. 1. SOMA Methodology Lifecycle [13]

IV. Design and Analysis

A. Business Modelling and Architecture

In this phase, we identify the existing business architecture and models and proposed a transformation plan. We have also used SWOT and Porter's Value Chain to support service requirements analysis process. After performing SWOT analysis, it is concluded that BPN has very strategic strengthness and supported by high technological opportunity, but must compromize low level of public trust in BPN professionalism and low level of public awareness regarding the importance of the land legality.

BPN has published Standard Operating Procedures (SOP) for existing condition as described in figure 2. The proposed service blueprint will minimize interaction with the user through counter, by diverting service through the online system. In figure 3, we proposed two kind of on stage/visible contact actions which are technology (online systems) layer and employee layer.

B. Solution Management

SOMA has a flexibility because there are different approaches for SOA migration depending on the decision made: to create custom software, to use legacy applications or to integrate package applications [13]. The specific part of each method is described in a solution template: roles, deliverables, and tasks. In this paper, we proposed a new online system for HGU registration and conduct package applications integration with existing financial and complain management systems.

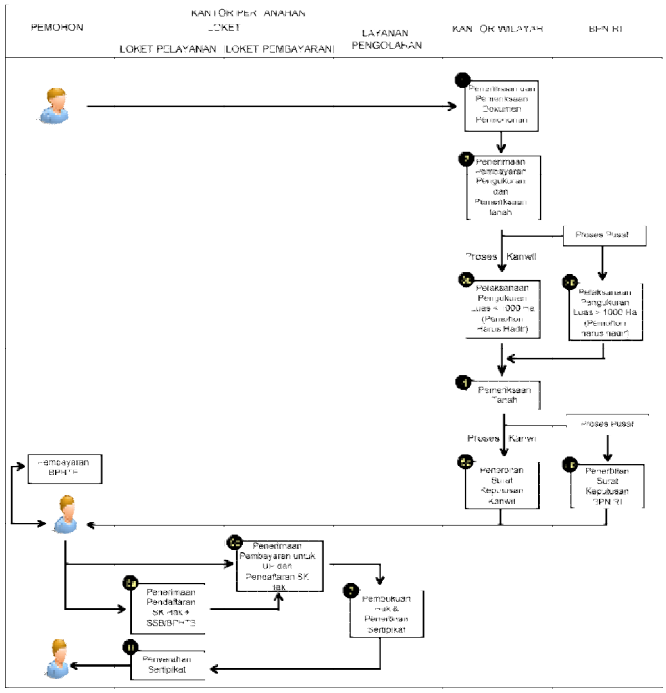

Fig. 2. Existing SOP for Renewal of Individual HGU Service [18]

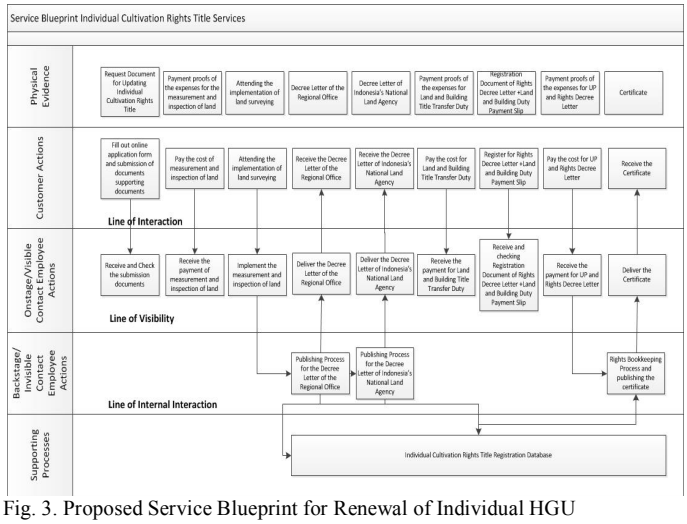

Fig. 3. Proposed Service Blueprint for Renewal of Individual HGU

C. Identification

This phase follows three main service identification techniques: goal service modeling, domain decomposition, and existing asset analysis [8], [13]. Existing assets analysis reflects existing software and application investments [19]. After all candidate services are identified, Service Litmus Test is applied in order to refactor and rationalize service portfolio before being handled for specification [13].

Goal service modelling (GSM) consists of a generalized statement of business goals is decomposed into sub-goals that must be met, which is evaluated using Key Performance Indicators (KPIs) [8], [13]. The detailed GSM is described in table 1.

TABLE I. GOAL SERVICE MODELLING

Goals & Subgoals	KPI	Metric	Services
Providing excellent service to the public for certificate update of individual cultivation rights service	Improve public satisfaction to the BPN service Increasing public participation in using the BPN service	Number of users that satisfied with the BPN service are increased Number of public participation using the BPN service are increased	
a. Opening service online registration of certificate update of individual cultivation rights	Increasing public participation in using the service	Number of public participation are increased	– Create account – Remove account – Validate transaction – Get certificate status – Validate identity – Get measurement status – Completion of the requirements document – Checking the status of land surveying – Checking the status of SK Rights & SSB / BPHTB – Checking certificate issuance report – Get registration status
b. Opening service complaints to the online registration system of Cultivation Rights	Improve public satisfaction to the service	The number of users that satisfied are increased	– Create account – Remove account – Make complaint – Checking the complaint response – Closing the case
c. Opening the integrated and transparent financial payment service	Improve public satisfaction to the service	The number of users that satisfied with the service are increased	– Create account – Remove account – Pay fee – Process payment

Due to domain decomposition step, we aim to break down and detail of high level process into services. Business domain related to the case study are further partitioned into functional areas. This process is performed to produce a set of loosely coupled subsystems as logical IT boundaries in order to carry business functionalities [8]. Result of this process can be described in table 2, which business domain for renewal of individual HGU service and payment management are crucial to realize the business goal and corporate strategy in this case study. So are their functional areas and subsystems, which will be further explained in more detailed diagram in next phase.

TABLE II. DOMAIN DECOMPOSITION

Domains	Functional Areas	Subsystems
Renewal of Individual HGU Service	Certificate Administration Customer Service Measurement and accounting	Certificate Processing
Complaints Management	Complaints Services Administrative complaints Response and feedback	Complaint Response Processing
Payment Management	Payment Services Billing and payment financial administration	Financial Transaction Processing
User Management	User administration Contact and event histories	Customer Profile

In existing asset analysis step, some of the processes that are currently existing on Renewal of Individual HGU still maintained and is considered not possible to be replaced by an online system, namely:

- Implementation of measurement and inspection of the land, and
- Handover the certificate

The handover of certificate is still through the counter, taking directly in the BPN office, not through Post or Courier considering importance of the document. While handover the Decree of Regional Office of BPN is diverted from the counter to Post and Courier by the system, because the document is merely administrative and notification., because the document is merely administrative and notification.

In addition there is 1 (one) interaction modified process, namely:

- Receiving and checking application documents

Is replaced into:

- Receive original documents that supporting application

This is because the original document is application form that is legally stamped must not be replaced electronically. Other documents are Identity Card and the SPPT PBB that legally required to be matched with a copy of the original document (either a photocopy or scan).

Besides that, the already available existing assets are:

- Certificate Documentation and Management
- Complaint Response Management
- Payment Transaction Management

D. Specification

Specification phase consists of some activities : service specification, subsystem analysis and component specification [13]. While performing service specification activity, we could determined a set of service operations and service hierarchy that are going to be exposed as Web services. To support service specification activity, we use UML diagram to elaborate service model design in terms of rules, composition, operations, messages and flows.

There are 5 types of actors in this case study, namely Administrator, Customer, Frontline BPN Regency, BPN Regional Representative and BPN headquarter. Sequence diagram for validating transaction in renewal of individual HGU service, which performed by customer, as can be described in figure 4 below, involve object of customer and transaction also operations and messages among them.

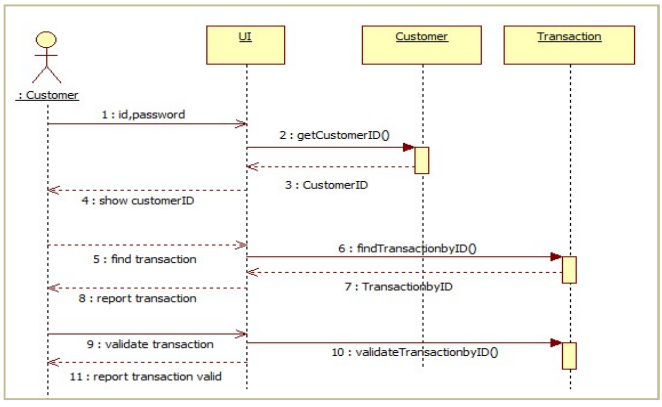

Fig. 4. Sequence Diagram for Validating Transaction

After performing service specification step, we analyze the required subsystem by identifying functional decomposition of functional areas. Main output of this activity, as described in figure 5 and 6, are subsystem dependency diagrams that show the dependencies of all subsystems and their interfaces to one another and identifies underlying existing assets. According to the result of domain decomposition step before, there are two main subsystem described in figure 5 and 6, which are crucial to realize the business goal and corporate strategy in this case study,

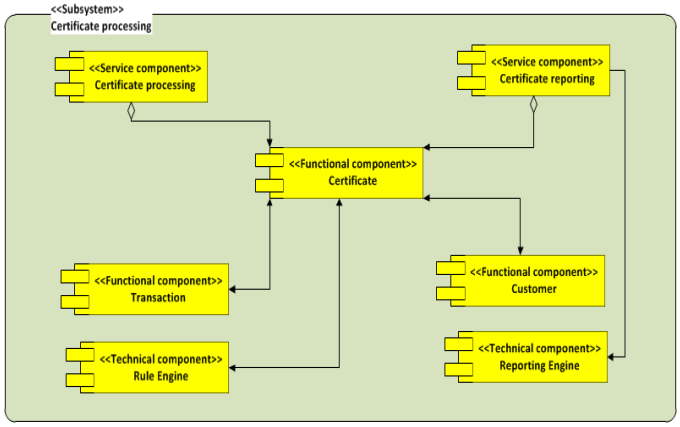

Fig. 5. Subsystem Dependency Diagram for Certificate Processing

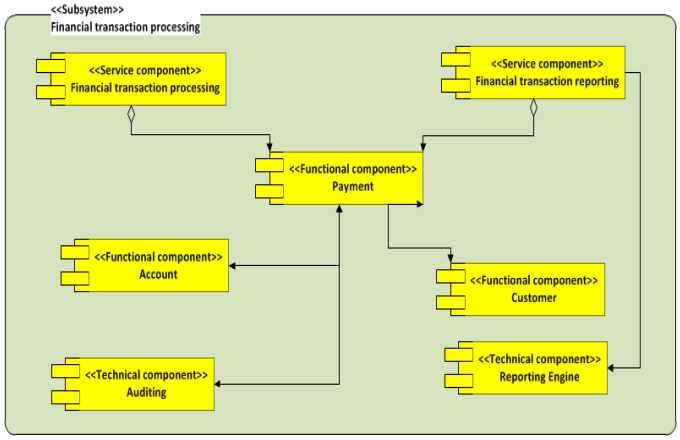

Fig. 6. Subsystem Dependency Diagram for Financial Transaction Processing

During component specification step, we conduct the static and dynamic behavior modeling of service components by defining interfaces of service component, developing component diagrams, performing dependencies identification on functional and technical components, and determining the internal flows. SOMA recommend to select such patterns as the enterprise component pattern in order to create a representation the inner structure of components for each of the service components and, depending on the complexity and function of the service components, generate the component specification from all or a subset of the enterprise component pattern to [13], as shown in figure 7 and 8.

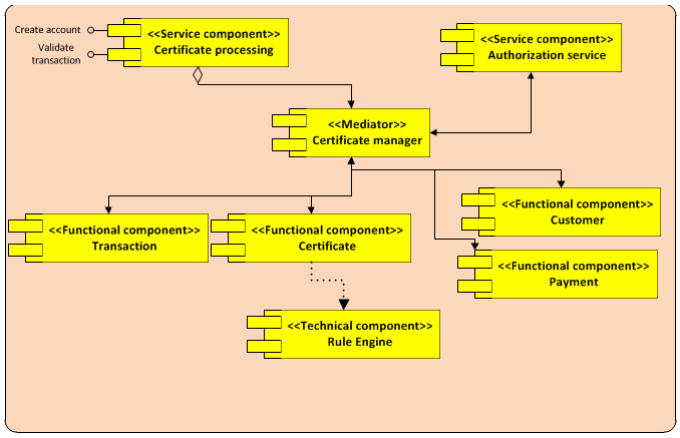

Fig. 7. Service Component Specification for Certificate (Static View)

In figure 7, certificate manager as a mediator is realization of certificate processing service components. The diagram in figure 7 and 8 also describes service component specification using the enterprise component pattern (static view) for certicate and payment.

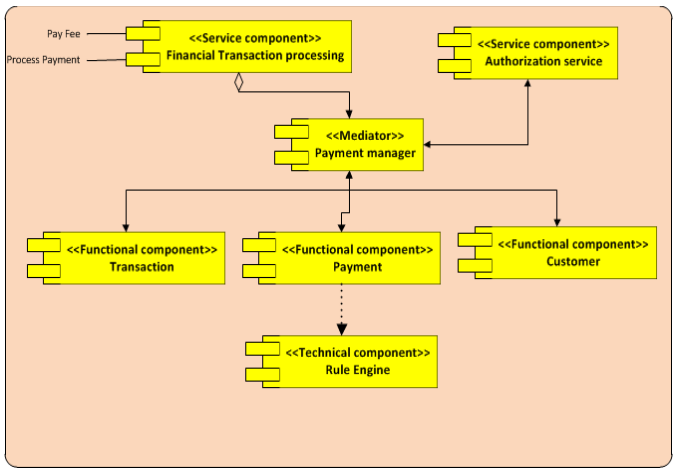

Fig. 8. Service Component Specification for Payment (Static View)

Regarding the completion of specification phase, we conduct service refactoring and rationalizing using Service Litmust Test (SLT) [13], [19], [20]. This activity is performed in order to ensure that services in the services hierarchy are refactored in such a way which lower-level services that have some kind of logical affinity are going to be grouped together under a higher-level service [8], [13].

E. Realization

A major output of realization phase is a SOA reference architecture layer [8]. In figure 9, it is clearly described instantiation of the architecture for this case study. It provides a dashboard view of the artifacts that are produced, which can be used to cover all aspects of SOA development. We have decided to prototype our service components in this step using Windows Communication Foundation (WCF) Framework and PHP SOAP.

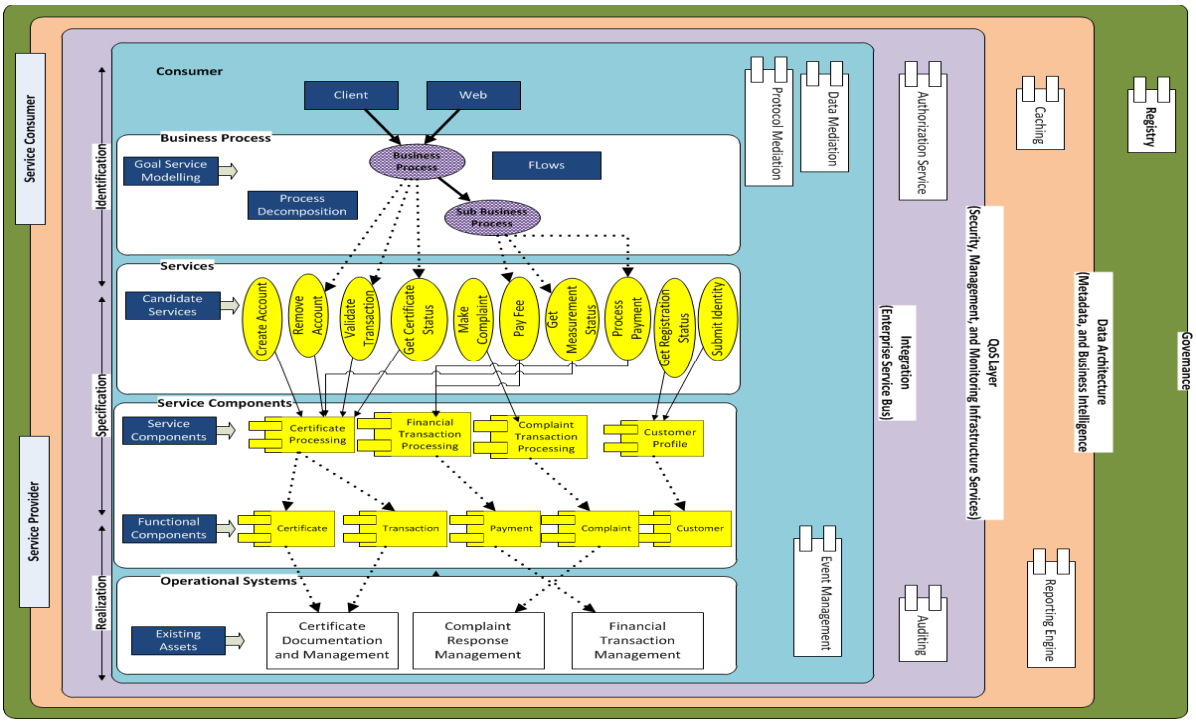

Fig. 9. Instantiation of the SOA reference architecture for the case study

V. IMPLEMENTATION AND TESTING

In this phase, we construct implementation of services. There are several technologies to develop web services such as SOAP and REST [21]. Despite their own advantages, we have decided to prototype our service components in this step using SOAP because of it built in error handling and increased privacy [21]. The new proposed online Individual HGU system is web based application. In other hand, the existing complaint management system and payment system have different platform and databases. As described in figure 10, the communication strategy among these applications is by using Web Service Definition Language (WSDL). WSDL is used for describing and formalizing web services and the current version makes it possible to separate service descriptions from the functions of the service.

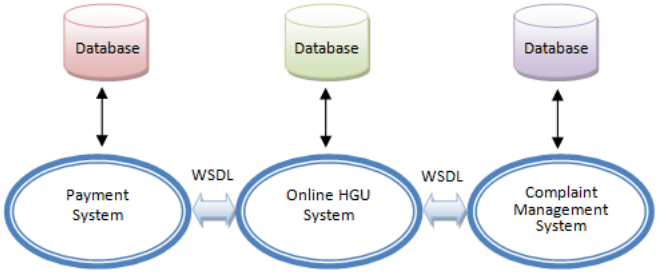

Fig. 10. Communication Strategy among Applications in Different Platforms and Databases

WSDL is implemented for each system : online HGU transaction, payment and complaint. All of application provide and consume service among each other through WSDL, which consist of description, operations, components and dependencies as described in implementation example fig 11.

```
<definitions xmlns="http://schemas.xmlsoap.org/wsdl/"
xmlns:tns="urn:TransaksiControllerwsdl"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/" xmlns:soap-
enc="http://schemas.xmlsoap.org/soap/encoding/"
name="TransaksiController"
targetNamespace="urn:TransaksiControllerwsdl">
<wsdl:types>...</wsdl:types>
<wsdl:message name="getStatusRequest"/>
<wsdl:message name="getStatusResponse">
<wsdl:part name="return" type="tns:TransaksiArray"/>
</wsdl:message>
<wsdl:portType name="TransaksiControllerPortType">
<wsdl:operation name="getStatus">
<wsdl:documentation/>
<wsdl:input message="tns:getStatusRequest"/>
<wsdl:output message="tns:getStatusResponse"/>
</wsdl:operation>
</wsdl:portType>
<wsdl:binding name="TransaksiControllerBinding"
type="tns:TransaksiControllerPortType">
<soap:binding style="rpc"
transport="http://schemas.xmlsoap.org/soap/http"/>
<wsdl:operation name="getStatus">
<soap:operation
soapAction="urn:TransaksiControllerwsdl#getStatus"
style="rpc"/>
<wsdl:input>
<soap:body use="encoded"
namespace="urn:TransaksiControllerwsdl"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
</wsdl:input>
<wsdl:output>
<soap:body use="encoded"
namespace="urn:TransaksiControllerwsdl"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
</wsdl:output>
</wsdl:operation>
</wsdl:binding>
<wsdl:service name="TransaksiControllerService">
<wsdl:port name="TransaksiControllerPort"
binding="tns:TransaksiControllerBinding">
<soap:address
location="http://localhost/simreg/transaksi/quote?ws=1"/>
</wsdl:port>
</wsdl:service>
</definitions>
```

Fig. 11. Implementation of WSDL for Online HGU transaction

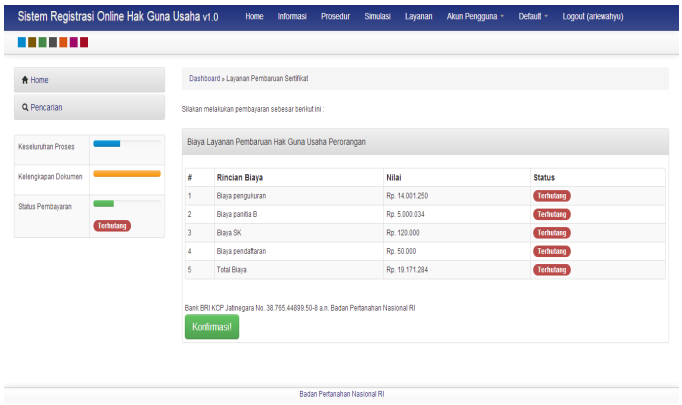

Fig. 12. Online Renewal of Individual HGU System

The customer only follows a step-by-step multiple form provided by online system to complete all registration steps, and confirm their payment status in the same system. While there are any complaint about registration process, the customer only have to fill out the form provided and receive the report and response in the same online system. This new business process make a simplification for the customer to get the HGU certificate easier and faster. Table 3 below provide a clear business process comparation before and after SOA integration in this case study.

TABLE III. BUSINESS PROCESS COMPARATION WHICH SUPPORT BPN PUBLIC SATISFACTION

Before SOA Integration	After SOA Integration
Customers complete all of registration steps at BPN branch office in workdays on working hour. Usually there is a busy queue.	Customers can complete all of registration steps every time and every where using online system, except land measurement attendance and certificate handover.
Customers manually pay registration fee in different teller officer at BPN office.	Customers can pay registration fee every time using their own online banking system or ATM transfer and proceed registration step on the same system.
Customers who wish to make a complaint write a complaint in paper, and then give to the complaint counter in BPN office	Customers can make a complaint every time regarding their own application in online system which is integrated with BPN complaint management system.
Estimation time to complete whole steps in renewal of individual HGU service at least 38 days	Estimation time to complete whole steps in renewal of individual HGU service can be minimized.

After SOA integration as described in table 3, the business process in BPN could be improved to optimize public satisfaction as follows:

- Quickness
- Real time responsive
- Efficiency, and
- Reduce duplications

A qualitative evaluation of those public satisfaction indicator after SOA integration in renewal of individual HGU service are provided in table 4 below. The evaluation was conducted after comparing the business process before and after SOA integration.

TABLE IV. QUALITATIVE EVALUATION AFTER SOA INTEGRATION

Public Satisfaction Indicator	Evaluation (After SOA Integration)	Checklist
Quickness	Average time of complete steps in business process can be minimized.	√
Real time responsive	Customer are able to complete the payment and complaint process and get updated system status real time.	√
Efficiency	Reduce customer cost and time used in completing whole steps, regarding transportation cost, etc. It is because online system can be accessed everytime and everywhere.	√
Reduce duplications	A single integrated system minimize multiple different application (registration, payment, and complaint system) which usually require similar data and forms.	√

VI. CONCLUSION

Based on the research results in this case study, there is a simplicity and feasibility for customers to access the service provided by BPN through integrated online registration system. Using SOMA, we are able to integrate the new proposed service with other existing services that use different platform. SOMA implementation provides a clear alignment among business processes which can be synchronized in order to provide maximum value to the organization. This result of study can give a contribution for better service integration in BPN, so its solidity performance to reach public trust and optimize public satisfaction as one of national priority agenda can be achieved. This paper also can contribute for this field of study by describing real world case study implementation of SOA solution in public sector.

Future research directions include the effectivity and efficiency measurement of SOA implementation in public sector. Also integration of SOA and Enterprise Architecture framework in public sector could be more investigated as a contribution to this field of study.

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