

Design of Waste Management Service System in Indonesia Based on Service Oriented Architecture (SOA): Go-Waste



Kevin Tee, Rike Nurjannah, Derrick Lee, Emil R Kaburuan

Abstract: *One of the problems experienced by big cities in Indonesia is rubbish. At present the community must pay for the cost of rubbish, whereas rubbish can be useful and profitable if managed properly. One way to manage waste properly is to save waste at the Trash Bank. At present there are already several garbage banks established, but the garbage banks that have been run are not yet optimal, not all people use these facilities. Lack of knowledge and infrastructure facilities hamper the waste management process at the garbage bank. Therefore, the authors propose the concept of an integrated system based on service oriented architecture (SOA) to integrate garbage pickup services, banks, garbage banks, cooperatives, gas, electricity, cable tv, public relations, e-commerce and health insurance as a means of supporting infrastructure to support waste management. The method in this study uses Systematic Literature Review (SLR). The results of this study are in the form of a waste management application design: Go-Waste which integrates waste pick-up service, banks, garbage banks, cooperatives, gas, electricity, cable tv, public relations, e-commerce and health insurance in one platform using a service oriented architecture (SOA).*

Keywords— *garbage bank; waste management service information system; service-oriented architecture (SOA).*

I. INTRODUCTION

One of the big problems experienced by Indonesia is waste management. It is undeniable that every year the population increases in harmony with this, it can be projected to increase the amount of waste generated will be even greater. Trash will always be there as long as life continues. The

Ministry of Environment and Forestry (KLHK) noted that in 2017 throughout Indonesia waste generation reached 65.8 million tons per year. While in Jakarta alone it was recorded that the volume of waste has reached 6,500 tons - 7,000 tons per day. This condition will continue to grow in accordance with environmental conditions. [1] Regarding waste management, a recent research on Sustainable Waste Indonesia (SWI) revealed that 24% of waste in Indonesia is still unmanaged, which means that of around 65 million tons of waste produced in Indonesia every day, around 15 million tons still pollute the ecosystem and the environment because it is not handled with action. [2] The high amount of unmanaged waste is influenced by various factors, namely the lack of adequate facilities and infrastructure for the garbage collection process and the lack of education regarding waste management. Infrastructure and optimization of waste services is still not a priority by the government.

One of the efforts made for waste management is the establishment of a waste bank. However, the garbage banks that have been run are not optimal, not all people use these facilities because of the lack of education and supporting infrastructure. Some existing applications only provide garbage pickup services and rewards from waste are given only in the form of balances that cannot be used immediately. Therefore, to facilitate the public, an information system is needed that can unite the various needs of waste management services that can integrate waste collection services, banks, garbage banks, cooperatives, gas, electricity, cable TV, public schools, e-commerce and health insurance.

II. RELATED WORKS

A. Service Oriented Architecture (SOA)

Service in the scope of SOA is a set of functions, procedures, or processes that will respond if requested by a client. SOA is a form of architectural technology that follows the principle of service-orientation (service-oriented). This service-orientation concept approaches you by dividing a big problem into a smaller set of services that aims to solve a particular problem. SOA is not associated with a particular technology, but rather towards an approach to the development of modular software. [3] As explained above, service-oriented is an approach that solves big problems by dividing them into small sets of services to deal with specific problems.

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An example of the problem decomposition into a set of services can be seen in the case of eating in a restaurant. When the customer comes to the restaurant he sits and calls the customer to order food, the waiter will record the customer's order and then the order is given to the kitchen team to cook. After the food is ready to be served, the food will be delivered to the customer by the waiter.

By using a service-oriented approach, problem solving can be divided into a collection of services in the form of ordering food, delivering kitchen orders, making food in the kitchen, and delivering food to customers. In addition to the definitions explained earlier, the service itself can be seen as a logical encapsulation of one or a certain set of activities. When exemplified in a business automation. Business automation is a set of activities arranged in steps as the implementation of business processes. The scope of services is unlimited, services can encapsulate a large process or only one small process step. This can be adjusted depending on needs. After all problems can be divided into several services, the solution of these problems must be solved by allowing all services to participate in an orchestration. For that there are several problems that must be owned by the service, namely how services are related, how services communicate, how services are designed, and how messages between services are defined.

B. Information System

The system can be interpreted as "a collection of components that mutually have a relationship between one another". While information is the result of data processing, which has more value. Information systems can be interpreted as a collection of interrelated components in organizations that have a relationship with information. [4] According to [5], information systems are collections of computer hardware and software as well as human devices that will process data using such hardware and software.

C. Waste Management

Waste management is an activity that has a systematic, comprehensive, and continuous flow that includes the reduction and handling of waste [2]. Basically, waste management is one of the many ways to manage the environment. However, in reality, there are sometimes deviations in the way of management, resulting in access that actually results in a negative impact on the environment itself. Weaknesses in operational management and limited operational costs plus the steps taken by professionals in handling solid waste are the main factors causing these problems, problems encountered in the operational management of waste management include [2]:

- Inadequate equipment capacity.
- Poor maintenance of tools.
- Difficult to foster implementation staff, especially casual daily staff.
- Difficult to choose operational methods that are appropriate to local conditions.
- Waste operation cycle is incomplete / interrupted due to the difference in responsibility.
- Sectoral coordination between government bureaucracies is often weak.
- Operational management is more focused on the implementation aspects while the control aspects are weak.
- Operational planning is often only short term.

According to [6], waste management in Indonesia, especially in a city knows 3 management groups, namely:

a. Management by Community Self-help. Waste management from the source to the garbage collection point or to other processing facilities. In cities, this management is usually carried out by RT / RW organizations with the activity of collecting garbage from garbage bins at the source of the waste, for example in houses being transported by means prepared by the community themselves, to the TPS.

b. Formal Management, Management is usually carried out by the city government or other institutions including the private sector appointed by the city. The first stage of waste disposal is carried out by the waste producer, the settlement area is usually carried out by the RT / RW where the waste is transported from the tub

D. SWOT

SWOT analysis is an acronym for Strength company), Weakness, Opportunities (Business opportunities) and Threats (Obstacles to achieving goals).

According to [7] SWOT analysis (SWOT analysis) is an effort made to recognize strengths, weaknesses, opportunities, and threats that determine company performance. External information about opportunities and threats can be obtained from many sources such as customers, government documents, suppliers, banks, partners in other companies.

According to [8], SWOT analysis is identity various factors systematically to formulate a strategy company. This analysis is based on logic that maximizes strengths and opportunities, but on the other side too for minimize weaknesses and threats. Here is an explanation from the factors mentioned: Opportunity Entrepreneur Resources Fits & Gaps Business Plan

- a. Strength:** Resources, abilities or variety other advantages that companies have to be able to compete with its competitors.
- b. Weakness:** Limitations, deficiencies or obstacles from resources, capabilities and capabilities hampering the continuity of the company's business process.
- c. Opportunities:** Factors or conditions from outside the company which can benefit the company.
- d. Threats:** Factors or conditions from the outside that are not profitable for the company and can be threatening the existence of the company.

Table 2.1 SWOT Analysis

Internal	Strength (S)	Weakness (W)
External		
Opportunities (O)	SO Use power for to take advantage of opportunity	WO Resolve weakness with to take advantage of opportunity



Threats (T)	ST Use power for avoid threat	WT Minimize weakness and avoid threat
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Following is the description of the SWOT matrix above:

- SO Strategy**, This strategy utilizes internal strength companies to look for external opportunities as much as possible.
- ST Strategy**, Strategy that uses power internal company to avoid or reduce threats from external parties.
- WO Strategy**, This strategy aims to improve company's internal weaknesses with take advantage of opportunities from the external.
- WT Strategy**, This strategy aims to reduce company's internal weaknesses in a way

III. RESEARCH METHOD

The author uses 2 types of methodologies to conduct this research. The methodology used in this study is Observation and SWOT Analysis.

A. Observation

The author made observations, interviewed 20 people and gave questionnaires to 100 respondents to prospective customers taken from the Jabodetabek with the status of working with ages from 23 to 60 years to make a SWOT analysis and find the need.

B. SWOT Analysis

The analysis in this study is to use a SWOT analysis, which using this method can show the company's performance. SWOT analysis compares between internal factors, namely strength (strength), and weakness (weakness). With external factors, namely opportunities, and threats.

IV. RESULTS AND DISCUSSION

Based on observations, interviews and questionnaires conducted by the authors, the authors obtained a SWOT analysis, Application Architecture and SOA Layer.

A. SWOT Analysis

Go-Waste provides applications using integrated technology related to waste management services, both waste pick-up services and other needs provided by the Go-Waste application. Go-Waste also provides the most complete features such as the integrated features with banks so that the money generated from the sale of direct waste can be transferred to an account and integrated with gas electricity, water supply and so on so that the balance generated from the sale of direct waste can be used for purposes, this is which is the strength of Go-Waste compared to other competitors. Besides having strengths, Go-Waste also has a weakness that is not everyone understands the current technological developments and the difficulty in carrying out new maintenance services when getting lots of requests. Opportunity Go-Waste is the volume of waste that is increasing along with the increasing population and the pattern of consumerism. But what is threatening for Go-Waste is the growth of technology-based waste management services which is increasingly becoming a threat to us in improving service quality. And the difficulty of overcoming

the challenges for system security in terms of payment, and others.

S Strength	W Weakness	O Opportunity	T Threat
- Using integrated technology - Providing services as needed with the most complete features	- Only used for people who can use the internet and information technology - Maintenance new service	- Increasing population and consumerism patterns are in line with the increasing volume of waste.	- Increasing the growth of technology-based waste management services - Security system

Figure 4.1 SWOT Analysis

From Picture 4.1, you can get Strengths, Weakness, Opportunities and Threats. The following is the description:

1. Strengths

- Using integrated technology
- Providing services as needed with the most complete features

2. Weaknesses

- Only used for people who can use the internet and information technology.
- Maintenance new service.

3. Opportunities

- Increasing population and consumerism patterns are in line with the increasing volume of waste.

4. Threats

- Increasing the growth of technology-based waste management services.
- Security system

B. Application comparison

In this study, the authors make comparisons with similar applications namely Simalu and Angkuts. The following are the results of research on these 3 applications:

Name Application	Go-Waste	Simalu	Angkuts
Platform	Android, Ios and website	Android and website	Android and website
Garbage pick up	✓	✓	✓
Bank	✓	×	×
Garbage bank	✓	×	×
Cooperative	✓	×	×
Gas	✓	×	×
Electricity	✓	×	×
Cable tv	✓	×	×
PDAM	✓	×	×
e-commerce	✓	×	×
Health Insurance	✓	×	×

Table 4.1 Analysis of Similar Application

Based on the analysis results, in Table 4.1 it can be seen that the application designed has more complete features than the Simalu and Angkuts applications. In the Simalu and Angkuts application there are no integrated features with banks, garbage banks, cooperatives, gas, electricity, cable tv, public relations, e-commerce and health insurance.

C. Rich picture Go-Waste

After reviewing some literature and making comparisons with similar applications, the authors conclude that people need applications that can facilitate waste management that provide complete and integrated services. The author designed this application using a service-based architecture (SOA) that can integrate multiple entities in one platform. The following is a SOA-based system design which can be seen in Figure 4.2 below.

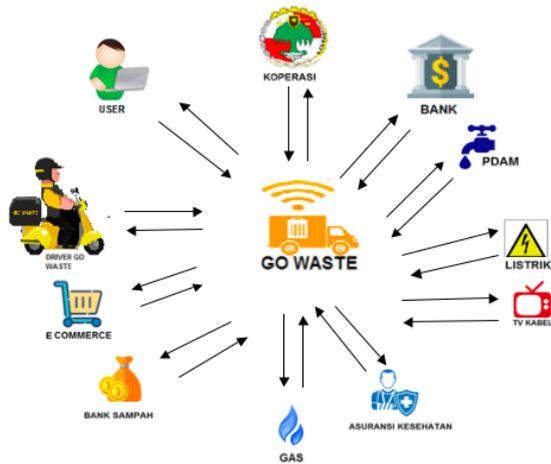


Figure 4.2 Rich Picture Go-Waste

The system offered is integrated on many key attributes. Among them: garbage pick-up service, money generated from garbage transactions can be transferred to a bank account, can save at a garbage bank, make savings and loans in cooperatives, gas purchases, electricity payments, cable television payments, payment of electricity, payment and sales in e-commerce and health insurance payments. Users can sell and buy recycled waste.

D. Design of Prototype

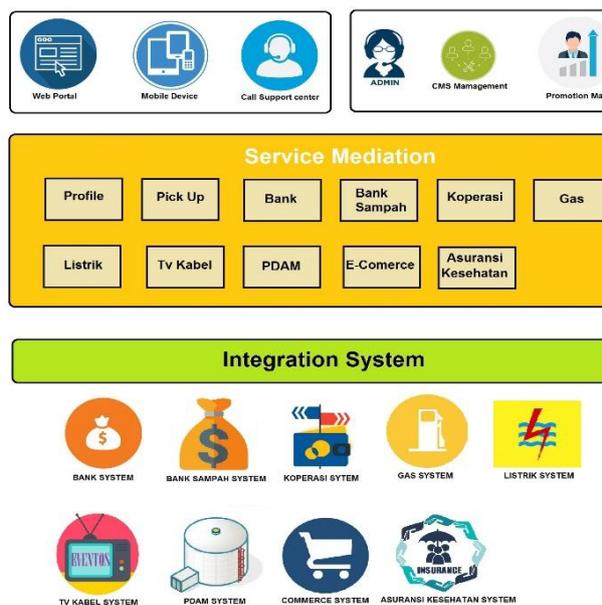


Figure 4.3 SOA Layer

Picture 4.3 the following is a description of the SOA layer for Go-Waste:

1. Service mediation: service mediation Go-Waste through web portal, mobile device, customer support, admin, CMS, and promotion manager.
2. Core service: core services provided from Go-Waste is profile, pick up, bank, garbage bank, cooperatives, gas, electricity, cable television, public relations, e-commerce and health insurance
3. Integration service: integration service in the Go-Waste is with banks systems, garbage banks systems, cooperatives systems, gas systems, electricity systems, cable television systems, public relations systems, e-commerce systems and health insurance systems.

Usage can be accessed through the website. With other services according to customer requirements. Provide Content Management System to provide important information for customers.

Go-Waste offers many features, such as; garbage pick-up service, money generated from garbage transactions can be transferred to a bank account, can save at a garbage bank, make savings and loans in cooperatives, gas purchases, electricity payments, cable tv payments, payment of electricity, payment and purchases in e-commerce and health insurance payments. Users can sell and buy recycled waste. Orders can also be canceled and refunded in accordance with applicable conditions. In addition to the refund feature, Go-Waste also offers a rescheduling schedule for pick-up waste.

This system is integrated with various vendors such as banks, garbage banks, cooperatives, gas, electricity, cable tv, public relations, e-commerce and health insurance.

V. CONCLUSION

Go-Waste is an application that integrates garbage pickup services, banks, garbage banks, cooperatives, gas, electricity, cable television, water supply, e-commerce and health insurance in one service. Various community needs in waste management can be accessed through Go-Waste. Suggestion for this application is to develop this application by adding new features to meet user needs and to work with the government.

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