Designing Solution for Organic Waste Management System with Design Thinking Approach (Case Study in Depok)

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Abstract. Depok is part of the agglomeration area of Jabodetabek (Jakarta Bogor Depok Tangerang Bekasi) which is classified as a metropolitan city. One of the problems that metropolitan cities faced including Depok is large volumes of organic waste that require special handling. Based on these problems, a special approach is needed to overcome the processing of organic waste in the city of Depok. The approach taken is expected to be able to see various perspectives from the parties involved in processing organic waste so that the alternative solutions can be created. This research uses design thinking, which consists of stages of empathise, define, ideate, prototype, and test. By using this approach, the impact on organic waste management can be more powerful.

1. Introduction
Increasing the number of population, in general, will cause an increase in the volume of waste produced [1]. These problems cause many disadvantages, including water and soil pollution at the garbage disposal site (TPA) due to the garbage in the mountain. This condition can be seen from the procedure of combustion of solid waste that is not yet appropriate so that it gives an impact on air pollution in urban areas [2]. The fundamental factors that cause low public health status in Indonesia are environmental factors (45%), behavior (30%), and health services (20%) [3]. In the 12th SDGs, the goal for every country in the world is to make waste management system as a national priority [4].

Depok has an area of with 200.29 km² a population of 1,179,813 inhabitants and produces 600 tons of garbage/day [5]. From this number, there are 528 tons/day of unmanaged waste. Organic waste management in Depok currently uses two methods, namely: landfill [6] and composting. Analysis of other management methods for organic waste is still needed. In this study, the design of an organic waste management system solution with approach design thinking will be carried out to assessing urban recycling [7].

2. Methodology
This research uses the design thinking method, which is divided into several stages [8] integrated with sustainable strategic development [9]. Several methods are used such Analytic Hierarchy Process (AHP), Substitute-Combine-Adapt-Modify-Put to another uses-Eliminate-Reverse (SCAMPER), Nominal Group Technique (NGT). General methods and tools can be seen in figure 1.
The observation phase is conducted by visiting the waste processing unit (UPS) randomly and continued with the stakeholder interview. This process involved UPS officers [10], and the community [11] by giving 16 questions which include identity, level of knowledge, challenging perspectives on garbage, opinions on waste management [12]. After getting the data, the researcher defines the problems that are felt by officers and the community.

To find out the views of policymakers, researchers interviewed representatives of the environmental and sanitation service as known as DLHK of Depok to took the value for pair-wise comparison matrix [13] as the basis for determining solutions. Then brainstormed ideas to resolve these problems, the best idea will be carried out to be an alternative solution with the involvement of stakeholders [14] The last stage after making a prototype idea is testing a prototype to assess the successful rate to solve the problem.

3. Result

3.1 Emphasize

The initial stage of the research is emphasize [15]. Based on the annual report, the total amount of waste managed on UPS for one month is shown around 843,694 Kg [16]. Comparing organic waste produced for one month, the amount of waste treated is still low. Also, the waste entering each UPS is not optimal. Therefore, researchers look for problems that cause this to happen, the problem can be seen in table 1.

| Description       | Human factor       | Facilities           | Program                        | System                |
|-------------------|--------------------|----------------------|--------------------------------|-----------------------|
|                    | Manual process     | Low response if the item is damaged | Mainstreaming socialization | Uncontrol Volume     |
|                   | The low of         | Transportation        | Feedback is less worthy         | Base on mutual trust |
|                   | contributions      | inefficiency          |                                |                       |

There are four factors in the problem of waste management as human, facilities, program, system. The problem is cause of pain in persona.

3.2 Define

After knowing the problems, researchers defines the characteristics of the community using pain and gain persona. The pain and gain person in the community can be seen in table 2.

| No. | Name | Pain                                                   | Gain       |
|-----|------|--------------------------------------------------------|------------|
| 1.  | Munir| Limited knowledge about waste management, does not have a network of environmental cadres | Community trust |
| 2.  | Anis | Difficult to socialize the program, no reward          | Togetherness |
| 3.  | Irsad| Control is difficult to do, old complaints are acted upon| Recognition |
Persona has pain and gain, the researchers want to increase the gain possessed by persona. To create solution, researchers needs problem solving’s criteria. In calculating AHP, the types of criteria and alternatives are determined to be known as the best choice [17]. Therefore, the researcher interviewed the DLHK to assess criteria are needed to design a system for processing organic waste in Depok City. Based on the AHP calculation, the most important criteria can be seen in table 3.

### Table 3. Most important Criteria by DLHK

| Criteria                          | Weight |
|-----------------------------------|--------|
| Involving Communities             | 0.558  |
| Easy to Use                       | 0.268  |
| Fast Implementation Time          | 0.133  |
| Affordable Cost                   | 0.042  |

The most importance criteria are involving communities (0.558), easy to use (0.268), fast implementation time (0.133) and affordable cost (0.042). The criteria used for determining solution.

### 3.3 Ideate

Researchers are brainstorming with NGT to accommodate ideas [18] based on operational problems, pain and gain persona and problem solving’s criteria that covered persona’s need. The result can be seen in table 4.

### Table 4. Result of NGT

| Ideas                                      | Persona’s Need                  |
|--------------------------------------------|---------------------------------|
| Designation of ambassadors for each district | socialization, complaints and network cadres of the environment |
| Awarding to the most cooperative environment | Award to environmental cadre |
| Making realtime system UPS                 | Control                          |
| Socialization through recitation mothers   | Education                        |

From the results of the NGT, it was combined into a communication system between district representatives to input data into a computer system and become a transparent waste management assessment facility for each region. The detail of solution arranged using SCAMPER.

### 3.4 Prototyping

The researcher makes application mockup to show how the function of the application. The application has some feature; the features are post, chat, report, performance, and map.

### 3.5 Testing

The testing has been done with giving several questions to know the prototype that can solve the problem or not [19]. The result of testing can be seen in table 5.

### Table 5. Testing

| No. | Persona’s Problem                        | Public Opinion |
|-----|------------------------------------------|----------------|
| 1.  | Limited knowledge about waste management | Solving        |
| 2.  | Complaints dealt                         | Not Solving    |
| 3.  | Limitations network environment’s volunteer |                |
| 4.  | Controlling the waste management is difficult |                |
| 5.  | difficult to socialize program           |                |
| 6.  | No reward obtained                      | Solving        |

5 of 6 communities needs are covered by the solution, the uncovered need because that is DLHK authority.
4. Discussion
This research involved 3 elements of waste management such as community, field officer, and government. The problems that occur in the field are known from the observation and interview process. The result obtained are used as base in defining pain and gain persona. In additional to gaining perspective in the field, researchers also sought out government opinions about organic waste management. From the interview, four criteria are needed in designing organic waste management solutions. These four criteria are needed in determining the solution of community needs for waste management. Waste management application that connect stakeholders and computerize data are the alternatives chosen based on NGT and SCAMPER because they cover the needs of the community and meet the criteria of policy makers. In the prototype testing process, 5 of 6 needs can be met. The reason is because one requirement that is not met depends on government policy.

5. Limitation
Research was only conducted in Depok city, involving 6 waste processing units, 7 people living in Depok city, and carried out in February-June.

6. Conclusion
Knowing field conditions and the community’s views on organic waste management are the foundation in this research to find alternative solutions for organic waste management. Through this research it is known that the management of organic waste in Depok city is not optimal. To solve the problem, the most importance criteria by DLHK are involving the community, easy to use, fast implementation time and finally affordable cost. The solution, waste management application which connect the stakeholder and computerize data are needed to meet the needs of the community. This is one thing that has not been met from the alternative solutions provided by this study, because it must be communicated with DLHK.

7. Acknowledgement
This study focuses on finding solutions to problems with organic waste management with a human centered approach. It is known the order of priority criteria in determining the solution based on policy makers.

8. Appendices
Form A.1

\[ \text{Value Eigen Vector} = \frac{\sum \text{Row}}{\sum \text{Column}} \]
\[ \lambda_{\text{max}} = (\sum \text{Column} \times \text{Eigen Vector}) + (\sum \text{Column} \times \text{Eigen Vector}) \]
\[ CI = (\lambda_{\text{max}} - n_1) / (n - 1) \]
\[ CR = CI / RI \]

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