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# *DESIGN OF APPROPRIATE TECHNOLOGY BASED ON WASTE TREATMENT EQUIPMENT USING VALUE ENGINEERING METHOD IN KEDUNG TURI*

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***ABSTRACT***
*The purpose of this research is to create a waste burner using raw materials from factory welding waste. The method used in this research is the value engineering method. In Gununggansir Village, there is an increase in waste, one of which is in Kedung Turi Hamlet, which is very significant, causing a buildup of garbage and inadequate waste management in Gununggangsir Village. This is an alternative that is made is an environmentally friendly waste incinerator. The process of making a garbage incinerator has the advantage of being environmentally friendly by using used goods that are not used and can still be used. In this research, what will be done is utilizing used goods that have value and function to achieve a target value. The result of using this used material is that it saves the cost of making Trush Burner which was originally worth Rp. 1,626,000 to Rp. 965,000.*
***Keywords :*** *Value Engineering Methods, Tool Design, Waste Treatment Equipment.*

## 1. Introduction

Garbage is one of the main problem factors in Gununggangsir village. Garbage has a negative impact on the surrounding ecosystem. Garbage pollution will cause an increase in the quantity and volume of waste waste in Gununggangsir village which can increase very significantly, causing a buildup of garbage and along with the population. Several ideas for short-term waste management solutions are still in progress. The handling of waste in Gununggangsir Village is inadequate, with this an alternative that can be made is an environmentally friendly waste incinerator. The process of making this garbage incinerator using used materials with effective waste treatment methods is used. The manufacture of this waste incinerator has the advantage of being environmentally friendly by using unused used goods and can still be put to good use . For this waste incineration device, it is necessary to use the value engineering method which is to achieve the best value, an identification process is required. to achieve the desired result. Consistent in quality and efficient use of this tool helps the community to deal with excessive waste. Therefore the researchers created this tool with used raw materials to produce the maximum (Anggraini et al., 2018; Omran, et al., 2021)

The method used to manufacture this environmentally friendly waste incinerator is value engineering. In this research, what will be done is to utilize used goods that have value and function to achieve a target value(Gusmarti et al., 2020). The manufacture of this tool utilizes used goods at the lowest possible cost and has the function of making this environmentally friendly waste burning tool. One of the techniques used to reduce costs in construction management is called value engineering. After the first design is completed, value engineering can be used to evaluate the results of the initial design. The goal of value engineering is to lower manufacturing costs as much as possible while still achieving the goals set in the initial design or planning phase (Hidayatullah & Mulasari, 2020; Sakr, et al., 2021).

The results of this study are expected to show how much efficiency costs can be saved for the manufacture of this tool by using value engineering techniques. There is a goal of this technique, namely in terms of developing an alternative or innovation that can minimize the cost of making the tool without compromising the function or quality of manufacture. So that the application of value engineering provides the expected optimal cost estimation results and can be carried out according to the plan(Ilayaraja & Zafar Eqyaabal, 2015; Abuhasel, et al., 2021) .

## 2. Methods

This research will take place in Gununggangsir Village, Kedung Turi Hamlet, which is located in RT.02/RW.02, Beji District, Pasuruan Regency, East Java. The research is carried out according to the time determined by the hamlet, this activity starts on December 10, 2021 until May 10, 2022 which takes six months.

- Data collection
  1. Observation

     Observation is a method of introducing the learning environment through observations of the surrounding environment by local individuals. The information collected is based on what is known about the field at the time of the study as primary data. Observation has two objectives: to provide knowledge and to facilitate the task of preparing an academic thesis proposal.
  2. Interviews

     Interviews are a process of extracting further information through dialogue and discussion with supervisors and local residents. The interview was conducted with the aim of facilitating the writing/compilation of the thesis, building self-confidence and practicing good and correct communication.
  3. Direct involvement

     Direct involvement is the stage of conducting research with direct participation in the activities of local residents by providing an expectation that the environment in Kedung Turi Hamlet has a clean environment and there are no residents in the village littering. Knowing the problems that occur in Kedung Turi Hamlet, I provide solutions according to the conditions of the surrounding environment.
- Data processing

  Data processing in this study is using the value engineering method. Value engineering is the stage used by analysis to optimize cost efficiency which has the potential to cause a cost overrun that results in and costs that are not needed in a project budget. After the value engineering process is carried out, it produces a cost efficiency value based on the principle that does not eliminate aspects of performance or performance, durability, reliability, quality, function and other important aspects of an element (Hitomi, 2017).
- Research Flowchart

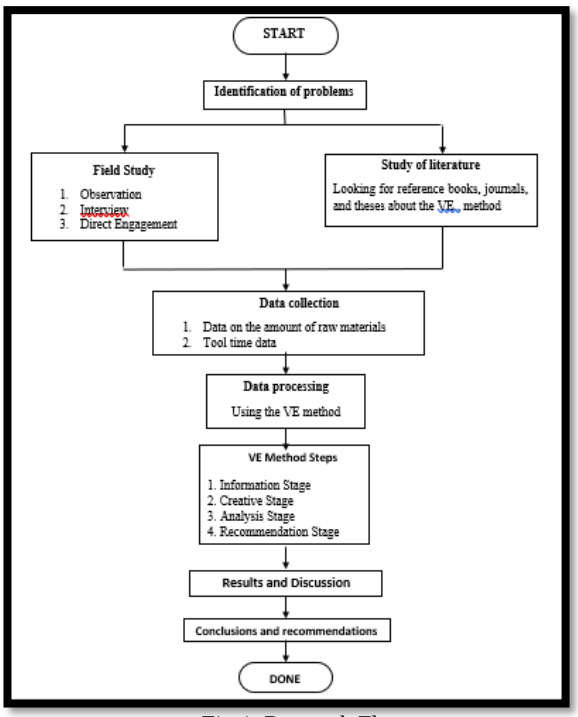


Fig 1. Research Flow

## 3. Results and Discussion

- Information Stage

The information stage is an effort to collect as much information as possible about the waste processing equipment, this is aimed at getting the information needed in the next stage. A waste treatment tool or Trush Burner is a tool that was created with the aim of reducing the habit of the people of Kudung Turi Hamlet throwing garbage indiscriminately (Putri et al., 2018). A more detailed description of the Trush Burner is as follows:

1. Uses

   The waste waste treatment tool or Trush Burner aims to process waste waste into ashes which will be used as a tool to reduce the amount of waste in Kudung Turi Hamlet.

2. How it works

   This waste treatment tool uses used oil and gasoline as fuel which is used to heat a stove filled with water and generate water vapor. Water vapor will enter the path provided and go to the nozzle to release a very strong steam and cause a greater fire pressure (Nur et al., 2017).

3. Tool making price list

   Based on the list of materials needed above, the following is a list of prices needed to make a Trush Burner:

Table 1 - Tool Making Price List

| Ingredient | Quantity/size | Cost |
|---|---|---|
| Drum | 2 pcs | Rp. 400.000 |
| 5mm thick plate | 2x1 m | Rp. 500.000 |
| 8 mm diameter diameter concrete iron | 36 m | Rp. 100.000 |
| wind nozzle | 1 pcs | Rp. 70.000 |
| speedometer | 1 pcs | Rp. 60.000 |
| 3mm thick pipe | 1 m | Rp. 80.000 |
| wind sprayer | 1 pcs | Rp. 50.000 |
| brass faucet | 2 pcs | Rp. 120.000 |
| Caliper hose | 1 pcs | Rp. 150.000 |
| Soft thread | 2 pcs | Rp. 60.000 |
| box iron | 4 m | Rp. 36.000 |
| Total | | Rp. 1.626.000 |

- **Functional Analysis Stage**

The next step in the VE study is function analysis. At this stage, identification of functions consisting of active verbs and nouns will be carried out, this identification is carried out randomly and then each type will be grouped and identified(Iswati, 2017)

***1. Activity Function Matrix***

Table 2 - *Activity Function Matrix*

| WORK | VERB | NOUN | FUNCTION |
|---|---|---|---|
| Manufacture of waste treatment equipment (trash burner) | Reduce | Amount of trash | Primary |
| | Process | Garbage turns to ashes | Secondary |
| | Make it easy | Garbage burning | Primary |
| | Prevent | Garbage accumulation | Secondary |
| | Guard | Environmental Hygiene | Secondary |

### *2.* FAST Diagram

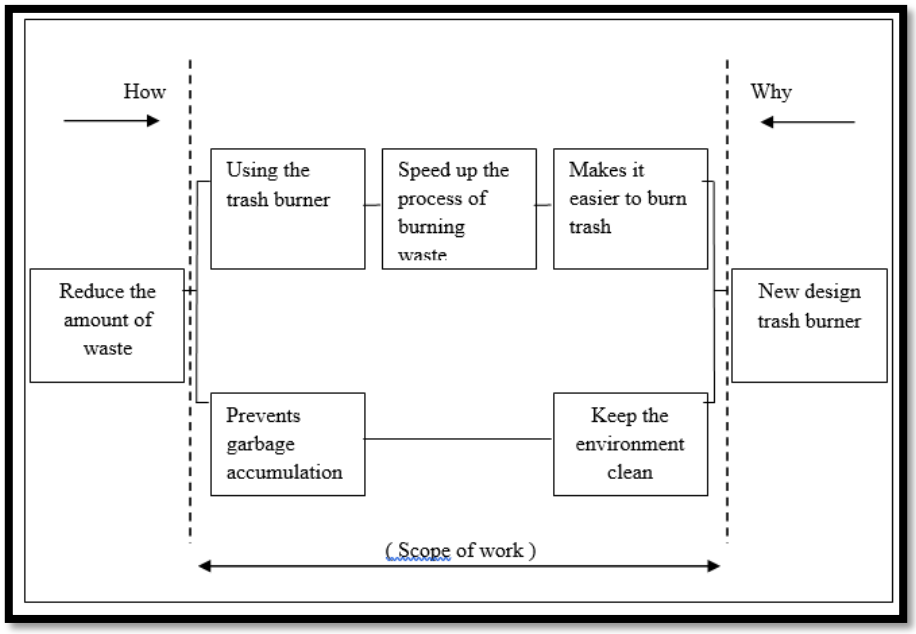


Fig 2. FAST Diagram Trash Burner

- **Creative Stage**

After carrying out the function analysis stage, the next stage is the creativity stage. At this creative stage, it is applied in the form of alternative waste processing tools or trash burners and the design of the cost of making these alternatives(Supriyanto, 2013). The alternatives given in the manufacture of waste processing equipment or trash burners are as follows:

Table 3 – Alternatives for Making Trush Burner

| Alternative | Description |
|---|---|
| 1 | Using used materials that are suitable for use as the main ingredients for making Trush Burner tools |
| 2 | Reduced the size of the Trush Burner to times smaller than the initial fixed size with the new material. |

Based on the alternatives above, the cost of making a trash burner is as follows:

Table 4 – Trash Burner Manufacturing Cost

| Description | Quantity | Prive/pcs | Total |
|---|---|---|---|
| Alternative 1 | | | |
| Drum | 2 pcs | Rp.150.000 | Rp.300.000 |
| 5mm thick plate | 2x1 m | Rp.200.000 | Rp.200.000 |
| 8 mm diameter diameter concrete iron | 36 m | Rp.50.000 | Rp.50.000 |
| wind nozzle | 1 pcs | Rp.50.000 | Rp.50.000 |
| speedometer | 1 pcs | Rp.40.000 | Rp.40.000 |
| 3mm thick pipe | 1 m | Rp.60.000 | Rp.60.000 |
| wind sprayer | 1 pcs | Rp.10.000 | Rp.10.000 |
| brass faucet | 2 pcs | Rp.15.000 | Rp.30.000 |
| Caliper hose | 1 pcs | Rp.100.000 | Rp.100.000 |
| Soft thread | 2 pcs | Rp.20.000 | Rp.40.000 |
| box iron | 4 m | Rp.15.000 | Rp.15.000 |
| Total | | | Rp.905.000 |
| Alternatives 2 | | | |
| Drum | 2 pcs | Rp.200.000 | Rp.200.000 |

| | | | |
|---|---|---|---|
| 5mm thick plate | 2x1 m | Rp.500.000 | Rp.500.000 |
| 8 mm diameter diameter concrete iron | 36 m | Rp.50.000 | Rp.50.000 |
| wind nozzle | 1 pcs | Rp.70.000 | Rp.70.000 |
| speedometer | 1 pcs | Rp.60.000 | Rp.60.000 |
| 3mm thick pipe | 1 m | Rp.80.000 | Rp.80.000 |
| wind sprayer | 1 pcs | Rp.50.000 | Rp.50.000 |
| brass faucet | 2 pcs | Rp.60.000 | Rp.120.000 |
| Caliper hose | 1 pcs | Rp.150.000 | Rp.150.000 |
| Soft thread | 2 pcs | Rp.30.000 | Rp.60.000 |
| box iron | 4 m | Rp.36.000 | Rp.36.000 |
| Total | | | Rp.1.376.000 |

Comparison of the two alternatives based on the time of manufacture and the usefulness of each trash burner is as follows:

Table 5 – Comparison of Alternatives

| Alternative | Description |
|---|---|
| Alternative 1 | |
| Time of realization | The time required to manufacture alternative 1 trash burner is 463 minutes |
| Capability processing waste | processing capability alternative 1 is the same as the initial design, which is able to burn 50 kg of waste in one process for approximately 20 minutes |
| Alternative 2 | |
| Time of realization | The time used for making alternative 2 trash burner is 485 minutes |
| Ability processing Waste | The ability of waste processing in alternative 2 is not as good as the initial design , due to the smaller size, the ability of the alternative 2 trash burner can only burn 20 kg of garbage in 20 minutes. |

- **Evaluation**

Stage The evaluation stage discusses the alternative waste processing tools that have been made in this creativity stage in the previous stage. At this stage, it is hoped that it can add a use value from a previous waste processing tool design(Kembuan et al., 2016). The steps that must be carried out are as follows:

a. Analysis of Advantages and Disadvantages

Table 6 – Analysis of Alternative Advantages and Disadvantages

| Alternative | Advantages | Disadvantages |
|---|---|---|
| Alternative 1 | Cost of manufacture The same incineration capacity of waste as the original design | The used materials do not have the same durability as new materials |
| Alternative 2 | The materials used are more durable because the materials used new | The ability to burn less waste |

b. Cost Analysis The

(A Pakpahan et al., 2018)Alternative design of this trash burner was analyzed in terms of costs in making it cheaper but could not reduce the value and function of the tool.comparison of these costs for the trash burner can be seen in the following table:

Table 7 – Alternative Costs

| No. | Alternative | Cost of alternative |
|---|---|---|
| 1 | Alternative 1 | Rp. 905.000 |
| 2 | Alternative 2 | Rp. 1.376.000 |

Based on the table above, there is alternative 1 which has a cost with manufacturing that is more affordable than alternative 2 and also the initial

design(Rachwan et al., 2016). Although the cost of making alternative 1 is affordable, the function of the waste processing equipment can be used properly because it uses materials that are still suitable for use and have good combustion capabilities. So it was decided that alternative 1 will proceed to the stage of perfecting a design.

- **Stages of Design Improvement The**

(Buede et al., 2016) Process of improving this design is from an alternative design process 1. And will be analyzed with the advantages and disadvantages of a design in the table below:

1. Analysis of Advantages and Disadvantages

Table 8 – Advantages and Disadvantages

| Design of Waste Processing Equipment (Trash Burner) Alternative 1 | |
|---|---|
| Advantages | Disadvantages |
| Cheap<br>Burning accommodates a lot | Used materials so that they are prone to damage |

Based on the table above, it is found that the disadvantages of alternative 1 have a shortage of used materials that are prone to damage, this will also result in the waste processing equipment being not as strong as new materials (Miles, 2015). The materials used such as scrap metal will be prone to rust because they have been used for a long time, this can be corrected by adding paint to the outer layer of the iron so that it reduces the speed of the iron rusting.

2. Manufacturing costs the

Materials used for the manufacture of trash burners are as follows:

Table 9 - Manufacturing costs

| Description | Quantity | Price/pcs | Total |
|---|---|---|---|
| Drum | 2 pcs | Rp.150.000 | Rp.300.000 |
| 5mm thick plate | 2x1 m | Rp.200.000 | Rp.200.000 |
| 8 mm diameter diameter concrete iron | 36 m | Rp.50.000 | Rp.50.000 |
| wind nozzle | 1 pcs | Rp.50.000 | Rp.50.000 |
| speedometer | 1 pcs | Rp.40.000 | Rp.40.000 |
| 3mm thick pipe | 1 m | Rp.60.000 | Rp.60.000 |
| wind sprayer | 2 pcs | Rp.10.000 | Rp.20.000 |
| brass faucet | 2 pcs | Rp.15.000 | Rp.30.000 |
| Caliper hose | 1 pcs | Rp.100.000 | Rp.100.000 |
| Soft thread | 2 pcs | Rp.20.000 | Rp.40.000 |
| box iron | 4 m | Rp.15.000 | Rp.15.000 |
| Paint oil | 1 can | Rp.60.000 | Rp.60.000 |
| Total | | | Rp. 965.000 |

The following is an appearance of the design and finished product of *Trush Burner* in Dusun Kudung Turi:

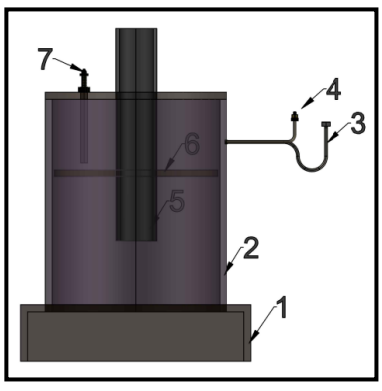

Fig 3. Stove Design *Trush Burner*

Figure 3 is a trush burner stove design, several parts of a trush burner stove are as follows:
1. Part 1 is a trash burner stove base made of iron plate
2. Part 2 is a trash burner stove wall made of of iron plate
3. Part 3 is a trash burner stove hose made of capillary pipe
4. Part 4 is a brass faucet
5. Part 5 is a 3 mm thick pipe
6. Part 6 is a plate
7. Part 7 is a wind nozzle

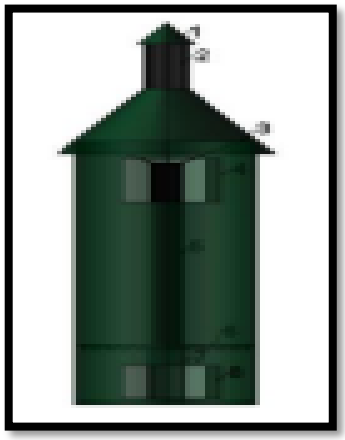

Fig 4. DesignTube Trush Burner

Figure 4 is a trush burner tube design, some parts of the trush burner tube are as follows:

Part 1 is the roof of the trash burner tube made of used drums.
2. Part 2 is a trash burner tube chimney made of used drums
3. Part 3 is a trash burner tube cover made from used drums
4. Part 4 is made of used drums
5. Part 5 is an iron frame for a trash burner tube made of iron concrete
6. Part 6 is made of a concrete iron frame that is shaped into a nest
7. Part 7 is a pipe that has a thickness of 3 mm
8. Part 8 is made of used drums

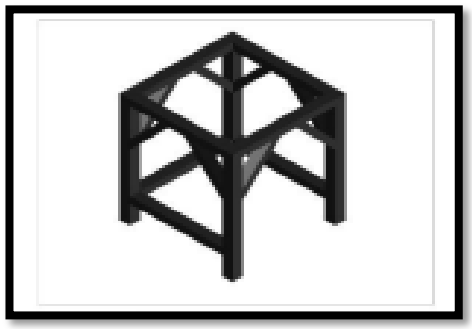

Fig 5. Place Design Trush Burner

Figure 5 is a trush burner holder design which is made of iron box that is useful as a place to place the trash burner.

Fig 6. Design Trush Burner Complete

Figure 6 is a complete design of the trash burner which is a waste treatment tool used for burning waste.

Fig 7. Finished Products Trush Burner

The specifications for the trash burner are as follows:
1. Capacity: 50 kg of waste
2. Materials: Steel plate, iron concrete, iron boxes and drums
3. Energy sources: Oil and gasoline
4. Materials tube : Used drum
5. Place material : Iron box
6. Stove material : Iron plate

## 4. Conclusions

The conclusions obtained in conducting a development of waste processing equipment or *Trush Burner* in Dusun Kudung Turi by using a *Value Engineering* , namely replacing the materials used with used materials suitable for use as a result of waste from the plate factory. With the use of this used material, the cost savings for making *Trush Burner* was obtained which was originally Rp. 1,626,000 to Rp. 965,000. *Trush Burners* that are made using used materials do not experience any loss of function because they are made in the same size and in the same way, only differ in materials. After doing the research, the suggestions obtained as input are that further research is expected to be able to develop better creative ideas without reducing the main function of the *Trush Burner*.

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