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TIME CALCULATION AND STANDARD OUTPUT ON HULLER MACHINE DESIGN OF DRY COFFEE SKIN SEPARATE MACHINE SEMI-AUTOMATIC ENTERPRISES ASHARI JAYA

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Abstract:*The stage of separating the coffee bean shell is one of the important processes in coffee processing. The separation of the coffee bean husks at the Ashari Jaya MSME uses two different machines so this separation process is carried out in two processes because during the process of separating the coffee bean husks in machine 1 it is still mixed with the peeled skin so it requires machine 2 to make these dry coffee beans clean from remaining skin mixture. The purpose of this machine design is to combine two machines into one, making it easier for workers to operate the machine, as well as more ergonomic in terms of size. With the dry coffee bean huller machine, it is hoped that it can increase the productivity of peeling dry coffee beans as well as relieve workers from the workload and reduce the risk of work accidents. The research method in designing this semi-automatic dry coffee bean huller machine includes conducting a survey of MSMEs processing Ashari Jaya coffee beans, identifying problems with these MSMEs, and formulating problems obtained from data collection. Furthermore, the data obtained were processed using the time and motion study method as a method of designing a machine operator work system accompanied by a data similarity test, and a data sufficiency test to determine the standard time and standard output. From the results of this study, it can be seen that testing using the old machine obtained a standard time of 2.8 minutes/kg and testing using a new machine obtained a standard time of 11.8 minutes/kg, then the increase in production productivity is 0.06 kg/second and the percentage increase in standard output by 88% with a productivity ratio of 1: 2.2*

INTRODUCTION

Indonesia is an archipelagic country that is rich in natural resources and occupies a strategic location on the world trade map. This makes many foreign traders visit Indonesia which causes assimilation between foreign and local cultures to occur. One of these assimilations is the Indonesian coffee culture which was entered at the end of the 15th

century by the Dutch. This has created a new habit and has become one of the most important types of drinks for Indonesian people to consume coffee every day until now.

Coffee has been cultivated in various regions of the world, and most of it is in developing countries. Based on data from The International Coffee Organization (ICO, 2018), the largest coffee producer in the world today is Brazil with a total production in 2017 of 51.5 million sacks (weight 60 kg per sack), followed by Vietnam (28.5 million). sacks), Colombia (14 million sacks), Indonesia (10.8 million sacks), and Honduras (8.349 million sacks). The trend of increasing consumption and the development of the coffee business in Indonesia is influenced by various factors, namely the development of science and technology in the field of processing and serving coffee that can increase consumer attractiveness to the product. Cafe outlets and coffee-based products are increasingly mushrooming in Indonesia, showing the potential for developing coffee for consumption in the country.

Before coffee can be drunk, it must go through a long process, starting from harvesting the ripe coffee beans either by machine or by hand, then processing the coffee beans, and drying them before turning them into logs. The next process, namely roasting with a level of varying degrees. After roasting the coffee beans are ground or ground into coffee grounds before the coffee can be drunk.

One of the coffee processing is the stage of separating the coffee beans from the skin which is one important things because in addition to reducing the water content in the coffee beans after harvest it also speeds up the drying process of the coffee. The technique and length of time in drying and separating the seeds after drying depends on the heat of the sun or the weather every day. At the stage of separating coffee beans and skins at the Micro, Small, and Medium Enterprises (MSMEs) processing Ashari Jaya coffee beans, which is located on Jl. Karanganyar, Poncokusumo District, Malang, East Java has used a machine that can accommodate one sack of dry coffee beans, where the weight of dry coffee beans per sack is 25 kg in one process. The process of separating dry coffee beans takes 15 minutes but does not include cleaning with coffee skin. Ashari Jaya SMEs can process 200-250 kg of coffee beans to be sent to several areas in East Java. The process can be improved by streamlining movements and the use of time to increase productivity.

According to (Rahmaniyah and Irwan, 2016), the purpose of improving non-ergonomic work systems is to produce an ENASE work system, which is effective, comfortable, safe, healthy, and efficient. The purpose of this goal is that it is hoped that a working system that is designed to be effective can produce output by the goals set, and is comfortable, safe, and healthy for workers and people who are around the workplace where the work takes place and is efficient in the sense that the costs required to complete a particular job are of little value compared to the output resulting from.

After the COVID-19 pandemic, we can only process 100-150 kg of coffee beans every day depending on consumer orders. Based on the increasing needs of consumers and to be able to meet consumer demand for timely availability of ground coffee, a smaller coffee bean separator is needed so that it can be placed in the warehouse where it operates and at the same time combine 2 machines into one or in one milling process can be done directly. so the coffee beans are clean and ready to be roasted. In this case, it is hoped that it can help overcome the problems that exist in Ashari Jaya's Micro, Small, and Medium Enterprises (MSMEs).

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1. Theoretical Basis

Kopi

The word coffee comes from the Arabic language, namely qahwah which means strength because at first coffee was used as a high-energy food. The word qahwah again changed to kahveh which came from Turkish and then changed again to koffie in Dutch. The use of the word *koffie* was immediately absorbed into the Indonesian language into the word coffee that is known today. Coffee is a drink made from brewed coffee beans that have been roasted and ground into powder. Coffee is one of the commodities in the world that is cultivated in more than 50 countries. Two varieties of coffee trees are generally known, namely Robusta Coffee (*Coffea* canephora) and Arabica Coffee *(Coffea* arabica*).*

Processing coffee before it can be drunk goes through a long process, namely harvesting ripe coffee beans either by machine or by hand, then processing the coffee beans and drying them before turning them into logs. The next process is roasting to varying degrees. After roasting the coffee beans are ground or ground into coffee grounds before the coffee can be drunk.

History records that the discovery of coffee as a nutritious and energy drink was first discovered by the Ethiopians on the African continent around 3000 years (1000 BC) ago. Coffee then continues to grow until it is now one of the most popular drinks in the world consumed by various groups of people. Indonesia itself has been able to produce more than 400 thousand tons of coffee per year. Besides the attractive taste and aroma, coffee can also reduce the risk of developing cancer, diabetes, gallstones, and various heart (cardiovascular) diseases. The definition of coffee according to experts is as follows:

1. Bhara L.A.M (2005)

Coffee is a type of plant that is made a drink with psychostimulant properties so that it causes someone who drinks it to stay awake (difficulty sleeping), reduces fatigue or stress at work, and can provide physiological effects, namely energy.

2. Saputra E (2008), Understanding coffee is a plant that has two main types, namely *Coffea* robusta and *Coffea* Arabica. Both types of coffee are very popular with the public, both in the country and people abroad.

Definition Ergonomics

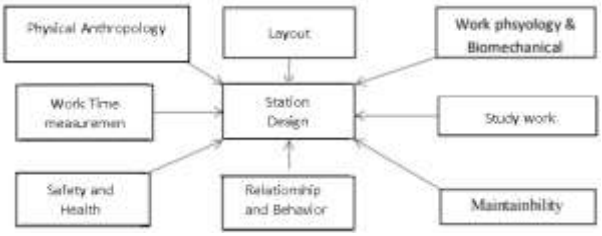
Ergonomics comes from two Greek words: ergon and nomos: ergon means work, and nomos means to rule, rule, or principle. Another opinion expressed by Sutalaksana (1979): Ergonomics is a science or rule that studies humans as components of a working system including physical and non-physical characteristics, human limitations, and abilities to design a system that is effective, safe, healthy, comfortable, and efficient. . The purpose of ergonomics is to improve the performance of the system by improving the quality of the relationship between humans and the machines used. The implementation of ergonomics in system design should make a system work better by eliminating unwanted aspects, such as inefficiencies, incidents, injuries, errors, difficulties in use, and others (Dr. Eng. Lusi Susanti, Hilma Raimona Zadry, Ph.,D, Berry Yuliandra, MT, 2015).

Work Facility Design

The design of work facilities in companies that can meet the requirements when

operated must have a good appearance, meet the specified performance standards, a fairly high level of reliability, while optimal use depends on the activity of the workforce to take advantage of the work facility design. Two principles of the application of the Human Integrated Design concept used in designing work facilities are:

1. A work facility designer must be well aware that the human factor will be the key to success in the use of work facility design.
2. It should also be realized that each product will require detailed information on all the factors involved in each design process. The design of work facilities can be influenced by several aspects originating from various existing disciplines (skills). The aspects that affect the design of this working facility are as follows, namely:



RULA Work Posture

According to Lueder in Triyanto (2012), explaining that RULA is a method developed in the field of ergonomics that invests in and assesses the work position performed by the upper body. This equipment does not perform special devices in providing measurements of neck, back, and upper body postures in line with muscle function and external loads supported by the body. This method uses diagrams of body postures and four scoring tables provided to evaluate hazardous work postures in the work cycle. Through this method, the maximum limit value and various worker postures will be obtained, the limit value ranges from 1 to 7.

Anthropometry

The term anthropometry comes from two words, namely "anthro" which means human, and "metri" which means size. Anthropometry is definitively stated as a study related to the measurement of the dimensions of the human body (Wignjosoebroto, 1995). According to Sanders and McCormick (1987) and Pheasant (1988) and Pulat (1992), anthropometry is the measurement of body dimensions or other physical characteristics of the body relevant to the design of something that people wear (Tarwaka et al, 2004). Anthropometry is widely used as ergonomic consideration in human interaction. Anthropometric data will determine the exact shape, size, and dimensions related to the product being designed and the human being who will operate the product.

The use of anthropometric data seeks that all tools are adapted to human abilities, not humans are adapted to tools. A design that has high compatibility with humans who use it is very important to reduce the occurrence of hazards due to work errors due to design errors.

Definition of Work System Design

Work system design is a science consisting of techniques and principles to get the best design of the work system concerned (Sutalaksana et al, 2006). In addition to this understanding, the definition of work system design can be seen based on the constituent words, namely:

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a. **Design**, in the General Indonesian Dictionary, the word design is defined as a process, method, act of organizing everything (before acting, doing, or doing anything), or planning.
b. **System**, about industrial engineering science, the system is a collection of components or elements that interact with each other and take action together to achieve a goal. The elements in question are man, method, machine, money, method, environment, energy, and information.
c. **Work**, Work is an activity to do something. Barnes et al (1980) stated that based on its history and development, the design of work systems was obtained from time study research conducted by F.W. Taylor and the motion study by F.B. Gilbreth, which was later combined into a time and motion study. In addition, work system design can also be referred to as engineering methods, work design, work-study, or job design. So that the design of work systems is closely related to the design of work methods. [12]

Time and Motion Study

Time and motion study is an activity to determine the time required by an operator (who has average and well-trained skills) in carrying out a work activity under normal working conditions and tempo. According to Marvin E. Mundel, the term time and motion itself can be interpreted in two ways, namely:

a. Motion study

The motion study aspect consists of descriptions, systematic analysis, and development of work methods in determining raw materials, output designs, processes, work tools, workplaces, and equipment for each step in a process of human activity that carries out each activity itself. The purpose of the motion study method is to determine or design an appropriate work method to complete an activity.

b. *Time study*

The main aspect of time study consists of a variety of procedures to determine the length of time required with established time measurement standards, for each activity that involves humans, machines, or a combination of activities. Wignjosoebroto (1995) explains that a time and motion study is a systematic study of work systems with the purpose of developing better systems and methods, standardizing systems and standards, setting time standards, and training operators. There are two kinds of time and motion study measurement techniques, namely:

a. Live time measurement

The measurement method is carried out directly, namely by observing directly the work carried out by the operator and noting the time required by the operator in doing his work by first dividing the work operation into work elements that are as detailed as possible on the condition that they can still be observed and measured. This direct measurement method can use the stopwatch time study and work sampling methods.

b. Indirect measurement of time

The method of measurement is by calculating the working time where the observer is not at the place of work being measured. This indirect measurement method uses standard time data (*Standard Data*) and movement time data (*Predetermined Time System*).

RESEARCH METHOD

Data Source Used

Data sources can be divided into two parts, namely primary data sources and secondary data sources:

1. Primary Data

Namely, data obtained directly from surveys and observations of the object of the problem under study, including operator anthropometric data, data on long machine work processes, data for taking documentation of body posture, as well as data for parts of the manufacture of the necessary tools.

2. Secondary Data

Namely, data obtained from other sources outside the object of research, including theories related to research problems.

Method of collecting data

Collecting the data needed for this research are:

1. Literature Study

Is a method of collecting data by reading literature or other books related to the problem under study as a theoretical basis that will be used as a guide in evaluating the object of research.

2. Field Research

Is a method of data collection done by observing directly the object under study

a. Observation

Direct observation when carrying out daily activities.

b. Interview

The research was carried out by collecting data by asking questions directly about matters relating to the object under study.

c. Documentation

The data collection technique is carried out by taking pictures of the object of the problem being studied.

Population and Sample

The population in this study were workers at the Ashari Jaya MSME which were taken as many as 35 samples from the operator of the dry coffee bean skin separation machine.

Place and time of research

Research place: Jl. Raya Karanganyar, Poncokusumo District, Malang Regency, East Java. Research time: April – August 2021

Data Analysis Method

The data analysis method is a statistical test consisting of a similarity test, data coverage test, both anthropometric data and working time data.

Design Flowchart

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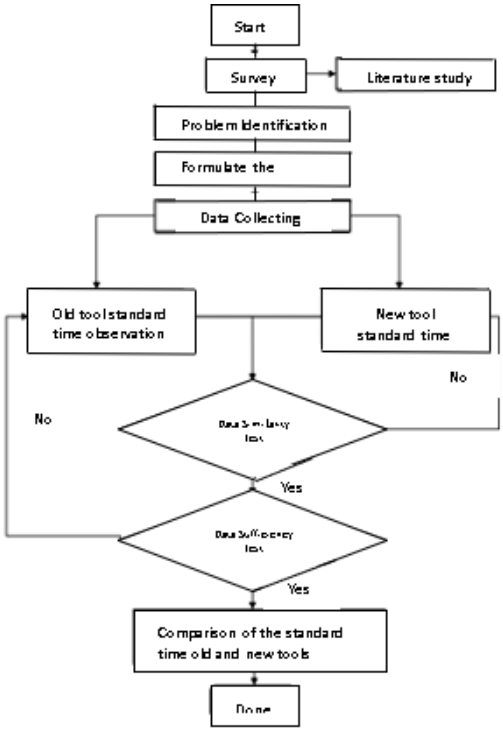


4. Data Collection and Processing

Data collection

The design of this tool is supported by some data collected to get results that are following the design objectives, whereas the results of measuring working time data are by the research objectives. The data used in assisting the design of the machine are as follows:

a. Qualitative data
b. Operator working time data related to the design of a semi-automatic dry coffee bean husk huller machine.

Qualitative Data

Qualitative data were obtained from interviews conducted with operators of the dry coffee bean husk separator machine to get direct information about what will be considered in the manufacture of a semi-automatic dry coffee bean husk separator huller machine. From this qualitative data collection, it can be seen that the machine needed is a machine that has a high level of security, can increase productivity, and has a comfortable work system for the operator.

Dried Coffee Bean Separator Machine Operator Working Time Data

Using Old Machine

In collecting data, the working time of the operator of the dry coffee bean separator was carried out using 2 kg of dry coffee beans in one process with thirty-five experiments. Observations were made when the operator operated the machine under the same working conditions and conditions, as well as the same amount of raw materials.

Data processing

Bringing the Sack Near the Machine

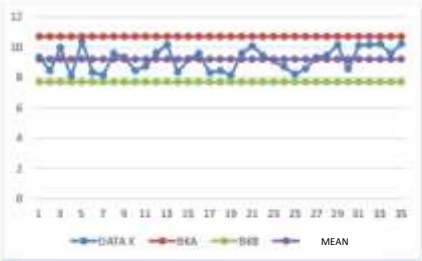
Sampel	X_i (Detik)	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1.	9.34	87.24	0.1	0.02
2.	8.44	71.23	-0.8	0.58
3.	9.98	99.60	0.8	0.60
4.	8.05	64.80	-1.2	1.33
5.	10.4	108.16	1.2	1.43
6.	8.35	69.72	-0.9	0.73
7.	8.14	66.26	-1.1	1.13
8.	9.59	91.97	0.4	0.15
9.	9.33	87.05	0.1	0.02
10.	8.46	71.57	-0.7	0.55
11.	8.73	76.21	-0.5	0.22
12.	9.63	92.74	0.4	0.18
13.	10.16	103.23	1.0	0.91
14.	8.35	69.72	-0.9	0.73
15.	9.21	84.82	0.0	0.00
16.	9.58	91.78	0.4	0.14
17.	8.32	69.22	-0.9	0.78
18.	8.46	71.57	-0.7	0.55
19.	8.14	66.26	-1.1	1.13
20.	9.59	91.97	0.4	0.15
21.	10.08	101.61	0.9	0.77
22.	9.45	89.30	0.2	0.06
23.	9.12	83.17	-0.1	0.01
24.	8.7	75.69	-0.5	0.25
25.	8.21	67.40	-1.0	0.99
26.	8.58	73.62	-0.6	0.39
27.	9.32	86.86	0.1	0.01
28.	9.46	89.49	0.3	0.07
29.	10.14	102.82	0.9	0.88
30.	8.55	73.10	-0.7	0.43
31.	10.12	102.41	0.9	0.84
32.	10.15	103.02	0.9	0.89
33.	10.21	104.24	1.0	1.01
34.	9.58	91.78	0.4	0.14
35.	10.23	104.65	1.0	1.05
$\sum$	**322.15**	2984.30		19.14

a. Data similarity

$$\bar{X} = \frac{\sum X_i}{N} = \frac{322,15}{35} = 9,20$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}} = \sqrt{\frac{19.14}{35-1}} = 0,75$$

UCL = $\bar{X} + k\,\sigma = 9,20 + 2 \times 0,75 = 10,70$
LCL = $\bar{X} - k\,\sigma = 9,20 - 2 \times 0,75 = 7,70$



Graphic 4. 1 Bringing sack near to Machine

b. Data sufficiency test

n (amount of sample) = 35
Level of trust 95%, k = 2
Level of accuracy 5%, s = 0.05

$$N' = \left[\frac{k/s\ \sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0,05\ \sqrt{35(2984.30) - (322,15)^2}}{322,15}\right]^2 = 10,32$$

Because N' < n, then data is enough

c. Calculating Standard time and Standard Output

Performance used is based on observations form operaor activities

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The performance is:

Class	Code	Value
Excellent skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02
Good consistency	C	+ 0,01
P1		**+ 0,16**

So, amount of performance (Po = 1) = Po + P1

= 1 + 0,16
= 1,16

While the allowance given by the operator is :

- Individual needs = 2%
- Factor affecting :
  - Expended energy factor = 9%
  - Work attitude = 2%
  - Work = 1%
  - Athmosphere = 6% +
  = 20%

Then calculate the cycle time (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

$$= \frac{322,15}{35}$$

= 9,20 second

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 9,20 \times 1,16$$

= 10,6 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 20\%}$$
$$= 10,6 \times \frac{100\%}{100\% - 20\%}$$

= 13,25 second

= 13,25 detik

Then, standard output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{13,25}$$

= 0,07 kg/second

Putting Coffee Beans into the Machine

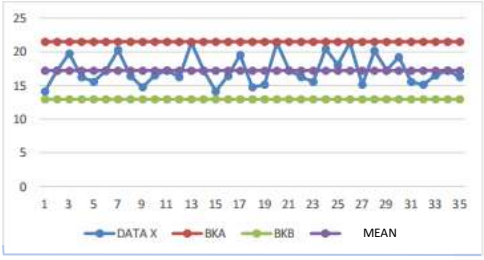
Sampel	X_i (Detik)	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1.	14.12	199.37	-3.10	9.59
2.	17.24	297.22	0.02	0.00
3.	19.75	390.06	2.53	6.42
4.	16.23	263.41	-0.99	0.97
5.	15.57	242.42	-1.65	2.71
6.	17.21	296.18	-0.01	0.00
7.	20.25	410.06	3.03	9.20
8.	16.41	269.29	-0.81	0.65
9.	14.73	216.97	-2.49	6.18
10.	16.48	271.59	-0.74	0.54
11.	17.25	297.56	0.03	0.00
12.	16.23	263.41	-0.99	0.97
13.	21.35	455.82	4.13	17.09
14.	17.21	296.18	-0.01	0.00
15.	14.12	199.37	-3.10	9.59
16.	16.41	269.29	-0.81	0.65
17.	19.55	382.20	2.33	5.44
18.	14.73	216.97	-2.49	6.18
19.	15.11	228.31	-2.11	4.44
20.	21.35	455.82	4.13	17.09
21.	17.25	297.56	0.03	0.00
22.	16.23	263.41	-0.99	0.97
23.	15.57	242.42	-1.65	2.71
24.	20.45	418.20	3.23	10.46
25.	18.05	325.80	0.83	0.69
26.	21.35	455.82	4.13	17.09
27.	15.11	228.31	-2.11	4.44
28.	20.15	406.02	2.93	8.61
29.	17.25	297.56	0.03	0.00
30.	19.23	369.79	2.01	4.05
31.	15.57	242.42	-1.65	2.71
32.	15.11	228.31	-2.11	4.44
33.	16.48	271.59	-0.74	0.54
34.	17.25	297.56	0.03	0.00
35.	16.23	263.41	-0.99	0.97
$\sum$	**602.58**	10529.77		155.40

a. Data similarity

$$\bar{X} = \frac{\sum X_i}{N} = \frac{602{,}58}{35} = 17{,}22$$

$$\sigma = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N-1}} = \sqrt{\frac{155{,}40}{35-1}} = 2{,}14$$

UCL = $\bar{X} + k.\sigma = 17{,}22 + 2 \times 2{,}14 = 21{,}49$
LCL = $\bar{X} - k.\sigma = 17{,}22 - 2 \times 2{,}14 = 12{,}94$



Graphic 4. 2 Putting Dry Coffee beans into Machine

b. Data sufficiency test

n (amount of sample) = 35
Level of trust 95%, k = 2

Level of accuracy 5%, s = 0,05

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Tingkat Ketelitian 5%, s = 0.05

$$N' = \left[\frac{k/s\ \sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\ \sqrt{35(10529{,}77) - (602{,}58)^2}}{602{,}58}\right]^2 = 23{,}96$$

Because N' < n, then data is enough

c. Calculating Standard time and Standard Output

Performance used is based on observations form operator activities

The performance is :

Class	Code	Value
Excellent Skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02
Good consistency	C	+ 0,01
P1		**+ 0,16**

Then amount of performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

While the allowance given by the operator is :

Sedangkan allowance yang diberikan oleh operator adalah :

- Individual need = 2%
- Factor affecting :
  - Expended power = 9%
  - Work attitude = 2%
  - Work = 1%
  - Atmosphere = 6% +
  - = 20%

Then calculate the cycle time (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

$$= \frac{602{,}58}{35}$$

= 17,22 second

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 17{,}22 \times 1{,}16$$

= 19,9 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 20\%}$$
$$= 19{,}9 \times \frac{100\%}{100\% - 20\%}$$

= 24,8 second

Then, standard output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{24{,}8}$$

= 0,04 kg/second

Peeling Skin (Using Machine

Sampel	X_i (Detik)	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1.	94	8836	3.23	10.42
2.	93	8649	2.23	4.97
3.	95	9025	4.23	17.88
4.	89	7921	-1.77	3.14
5.	91	8281	0.23	0.05
6.	90	8100	-0.77	0.60
7.	92	8464	1.23	1.51
8.	94	8836	3.23	10.42
9.	92	8464	1.23	1.51
10.	93	8649	2.23	4.97
11.	88	7744	-2.77	7.68
12.	90	8100	-0.77	0.60
13.	92	8464	1.23	1.51
14.	91	8281	0.23	0.05
15.	89	7921	-1.77	3.14
16.	87	7569	-3.77	14.22
17.	89	7921	-1.77	3.14
18.	91	8281	0.23	0.05
19.	90	8100	-0.77	0.60
20.	92	8464	1.23	1.51
21.	90	8100	-0.77	0.60
22.	92	8464	1.23	1.51
23.	94	8836	3.23	10.42
24.	92	8464	1.23	1.51
25.	93	8649	2.23	4.97
26.	88	7744	-2.77	7.68
27.	90	8100	-0.77	0.60
28.	89	7921	-1.77	3.14
29.	87	7569	-3.77	14.22
30.	89	7921	-1.77	3.14
31.	91	8281	0.23	0.05
32.	90	8100	-0.77	0.60
33.	92	8464	1.23	1.51
34.	90	8100	-0.77	0.60
35.	88	7744	-2.77	7.68
$\sum$	**3177**	288527		147.17

a. Data similarity

$$\bar{X} = \frac{\sum X_i}{N} = \frac{3177}{35} = 90{,}77$$

$$\sigma = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N-1}} = \sqrt{\frac{147{,}17}{35-1}} = 2{,}07$$

UCL = $\bar{X} + k.\sigma = 90{,}77 + 2 \times 2{,}07 = 94{,}92$

LCL = $\bar{X} - k.\sigma = 90{,}77 - 2 \times 2{,}07 = 86{,}62$

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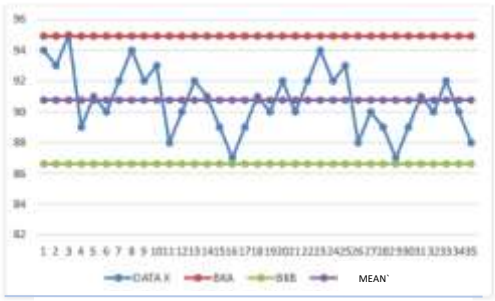

Graphic 4. 3 Peeling skin (Using Machine)

b. Data sufficiency test

n (amount of sample) = 35
Level of trust 95%, k = 2
Level of accuracy 5%, s = 0.05

$$N' = \left[\frac{k/s\ \sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\ \sqrt{35(288527) - (3177)^2}}{3177}\right]^2 = 0{,}81$$

Because N' < n, then data is enough

c. Calculating Standard time and Standard Output

Performance used is based on observations form operator activities

The performance is :

Class	Code	Value
Excellent skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02

Good consistency	C	+ 0,01
PI		**+ 0,16**

Then amount of performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

While the allowance given by the operator is :

- ❖ Individual need = 2%
- ❖ Factor affecting :
  - Expended power = 9%
  - Work attitude = 2%
  - Work = 1%
  - Atmosphere = 6% +
  - = 20%

Then calculate the cycle time (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

$$= \frac{3177}{35}$$

= 90.77 second

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 90,77 \times 1,16$$

= 105.2 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 20\%}$$
$$= 105,2 \times \frac{100\%}{100\% - 20\%}$$

= 131.5 second

Then, standard output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{131,5}$$

= 0,007 kg/ detik

Calculation Results of Dry Coffee Bean Skin Separation Process Using Old Machines

Based on the above calculations, the following results can be obtained:

Calculation Results of the Old Machine Data Similarity Test

No.	Data Type	N	$\bar{x}$	σ	UCL	LCL
1.	Bring the sack near the machine	35	9,29	0,75	10,70	7,70
2.	Put coffee beasne in the machine	35	17,22	21,49	21,49	12,94
3.	Peeling skin (using machine)	35	90,77	2,07	94,92	86,62

Calculation Results of Old Machine Data Sufficiency Test

No.	Data Type	n	N'	Result	Conclusion
1.	Bring sack	35	10,32	N' < n	Data

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	near to machine				Sufficient
2.	Bring Coffee beans into the machine	35	23,96	N' < n	Data Sufficient
3.	Peeling skin (using machine)	35	0,81	N' < n	Data Sufficient

Old Machine Calculation Results

No.	Data type	Performance	Allowance	Ws	Wn	Wb	Os
1.	Bring Sack near to machine	1,16	20%	9,20 second	10,6 second	13,25 second	0,07 kg/ second
2.	Putting Coffee Bean into the machine	1,16	20%	17,22 second	19,9 second	24,8 second	0,04 kg/ second
3.	Peeling skin (using machine)	1,16	20%	90,77 second	105,2 second	131,5 second	0,007 kg/ second

5. Results and Discussion

Work Time Calculation Results Using a Semi-automatic Dry Coffee Bean Huller Machine

New Machine Data Simi Test Calculation Results

No.	Data type	N	$\bar{x}$	σ	UCL	LCL
1.	Measuring dry coffee beans	35	8,80	0,62	10,04	7,55
2.	Putting coffee beans into the machine	35	4,42	0,57	5,56	3,29
3.	Peeling skin (using machine)	35	452,66	23,19	499,03	406,29

New Machine Data Sufficiency Test Calculation Results

No.	Data type	n	N'	Result	Conclusion
1.	Measuring dry coffee beans	35	7,77	N' < n	Data Sufficient
2.	Putting coffe beans into the machine	35	25,73	N' < n	Data Sufficient
3.	Peeling skin (using machine)	35	4,04	N' < n	Data Sufficient

New Engine Calculation Results

No.	Data type	Performance (Po =1)	Allowance	Ws	Wn	Wb	Os
1.	Measuring coffee beans	1,16	20%	8,80 detik	10,2 detik	12,75 detik	0,07 kg/second
2.	Putting coffee beans into the machine	1,16	20%	4,42 detik	5,2 detik	6,4 detik	0,15 kg/second
3.	Peeling skin (using machine)	1,16	20%	452,66 detik	252 detik	656,3 detik	0,001 kg/second

Discussion on Calculation of Drying Coffee Bean Skin Separation Using a New Machine
With a semi-automatic dry coffee bean huller machine with a capacity of 2 kg in one process for thirty-five trials. The process can be seen in the following table:

Measuring Dried Coffee Beans

Sampel / Sample	X_i X_t (Second)	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1.	9.36	87.80	0.57	0.33
2.	[illegible]	72.93	-0.26	0.07
3.	9.23	85.19	0.43	0.19
4.	9.58	91.78	0.78	0.62
5.	9.32	86.86	0.52	0.28
6.	8.46	71.57	-0.34	0.11
7.	9.14	83.54	0.34	0.12
8.	8.59	73.79	-0.21	0.04
9.	8.33	69.39	-0.47	0.22
10.	7.86	61.78	-0.94	0.87
11.	9.73	94.67	0.93	0.87
12.	8.51	72.42	-0.29	0.08
13.	9.16	83.91	0.36	0.13
14.	9.64	92.93	0.84	0.71
15.	8.21	67.40	-0.59	0.34
16.	8.58	73.62	-0.22	0.05

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17.	9.32	86.86	0.52	0.28
18.	7.46	55.65	-1.34	1.78
19.	9.14	83.54	0.34	0.12
20.	8.59	73.79	-0.21	0.04
21.	8.08	65.29	-0.72	0.51
22.	7.43	55.20	-1.37	1.86
23.	9.12	83.17	0.32	0.11
24.	8.58	73.62	-0.22	0.05
25.	9.21	84.82	0.41	0.17
26.	9.58	91.78	0.78	0.62
27.	9.32	86.86	0.52	0.28
28.	9.46	89.49	0.66	0.44
29.	8.14	66.26	-0.66	0.43
30.	9.43	88.92	0.63	0.40
31.	8.12	65.93	-0.68	0.46
32.	8.58	73.62	-0.22	0.05
33.	9.21	84.82	0.41	0.17
34.	8.58	73.62	-0.22	0.05
35.	8.23	67.73	-0.57	0.32
Σ	**307.83**	2720.56		13.15

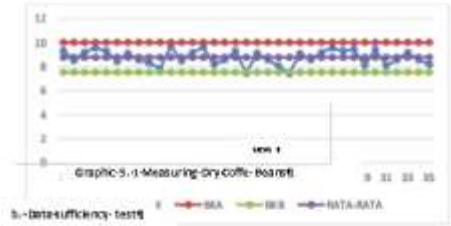
a. Data similarity

$$\bar{X} = \frac{\sum X_i}{N} = \frac{307,83}{35} = 8,80$$

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}} = \sqrt{\frac{13,15}{35-1}} = 0,62$$

UCL $= \bar{X} + k.\sigma = 8,80 + 2 \times 0,62 = 10,04$

LCL $= \bar{X} - k.\sigma = 8,80 - 2 \times 0,62 = 7,55$



Graphic 5.1 Measuring Dry Coffe Bean

1 Menakar Biji Kopi Kering

b. Tes kecukupan data

n (jumlah sampel) = 35
Tingkat Kepercayaan 95%, k = 2
Tingkat Ketelitian 5%, s = 0.05

$$N' = \left[\frac{k/s \sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0,05 \sqrt{35(2720,56) - (307,83)^2}}{307,87}\right]^2 = 7.77$$

c. Menghitung Waktu Standart dan Output Standart

Performance yang digunakan berdasarkan pengamtan dari kegiatan operator.

Performance tersebut adalah :

Kelas	Kode	Nilai
Excellent skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02
Good consistency	C	+ 0,01

P1	+ 0,16

Jadi besar performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

Then amount of performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

While the allowance given by the operator is :

- ❖ Individual need
- ❖ Factor affecting :
  - Expended power
  - Work attitude
  - Work
  - Atmosphere

b. Data su

n (a
Level of trust 95%, k
Level of accuracy 5%, s

Seh **n waktu siklus (Ws) :**

$$Ws = \frac{\quad}{N}$$

$$= \frac{107,81}{15}$$

= 8,80 second

Then calculate the cycle time (Ws) :

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 8,80 \times 1,16$$

= 10,12 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 2,0\%}$$
$$= 10,2 \times \frac{100\%}{100\% - 2,0\%}$$

= 12,75 second

The performance is :

Then, standard output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{12,75}$$

= 0,07kg/ second

Putting Dried Coffee Beans Into The Machine

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Sampel	X_i	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
Sample	X_t (Second))			
		28.84	0.95	0.90
		30.69	1.12	1.25
3.	5.23	27.35	0.81	0.65
4.	4.58	20.98	0.16	0.02
5.	4.32	18.66	-0.10	0.01
6.	4.46	19.89	0.04	0.00
7.	5.14	26.42	0.72	0.51
8.	4.59	21.07	0.17	0.03
9.	5.33	28.41	0.91	0.82
10.	4.86	23.62	0.44	0.19
11.	4.73	22.37	0.31	0.09
12.	3.51	12.32	-0.91	0.83
13.	4.16	17.31	-0.26	0.07
14.	3.64	13.25	-0.78	0.61
15.	4.21	17.72	-0.21	0.05
16.	4.58	20.98	0.16	0.02
17.	4.32	18.66	-0.10	0.01
18.	4.46	19.89	0.04	0.00
19.	5.14	26.42	0.72	0.51
20.	4.59	21.07	0.17	0.03
21.	4.08	16.65	-0.34	0.12
22.	3.43	11.76	-0.99	0.99
23.	4.12	16.97	-0.30	0.09
24.	3.58	12.82	-0.84	0.71
25.	4.21	17.72	-0.21	0.05
26.	4.58	20.98	0.16	0.02
27.	4.32	18.66	-0.10	0.01
28.	4.46	19.89	0.04	0.00
29.	5.14	26.42	0.72	0.51
30.	3.43	11.76	-0.99	0.99
31.	4.12	16.97	-0.30	0.09
32.	3.58	12.82	-0.84	0.71
33.	4.21	17.72	-0.21	0.05
34.	4.58	20.98	0.16	0.02
35.	4.23	17.89	-0.19	0.04
Σ	**154.83**	695.94		11.02

a. Data similarity

$$\bar{X} = \frac{\Sigma}{N} = \frac{}{35} = 4,42$$

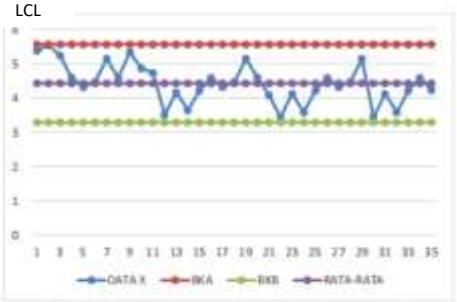
$$\sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{N-1}} = \sqrt{\frac{11.02}{35-1}} = 0,57$$

$$BKA = \bar{X} + k\,\sigma = 4,42 + 2 \times 0,57 = 5,56$$

$$= \bar{X} - k\,\sigma = 4,42 - 2 \times 0,57 = 3,29$$

UCL

LCL



Grafik 5. 2 Memasukkan Biji Kopi Ke Dalam Mesin

MEAN``

b. Graphic 5. 1 Measuring Dry Coffe Beans

b. Data sufficiency test

n (amount of sample)

Level of trust 95%, k

Level of accuracy 5%, s

$$N' = \left[\frac{k/s\sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\sqrt{35(695{,}94) - (154{,}83)^2}}{154{,}83}\right]^2 = 25{,}73$$

Because N' < n, then data is enough

c. Calculating Standard time and Standard Output

Performance used is based on observations form operator activities

Performance tersebut adalah :

Kelas	Kode	Nilai
Excellent skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02
Good consistency	C	+ 0,01
PI		**+ 0,16**

Jadi besar performance (Po = 1) = Po + PI
= 1 + 0,16
= 1,16

The performance is :

Class	Code	Value

Then amount of performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

While the allowance given by the operator is :

- ❖ Individual need = 2%
- ❖ Factor affecting :
  - Expended power = 9%
  - Work attitude = 2%
  - Work = 1%
  - Atmosphere = 6% +
  - = 20%

Selanjutnya dilakukan perhitungan waktu siklus (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

Then calculate the cycle time (Ws) :

$$= \frac{154{,}83}{35}$$

= 4,42 second

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 4{,}42 \times 1{,}16$$

= 5,12 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 20\%}$$
$$= 5{,}12 \times \frac{100\%}{100\% - 20\%}$$

= 6,4 second

Then, Standard Output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{6{,}4}$$

= 0,15 kg/second

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Sample	X_t (Second))

Sampel	X_i (Detik)	X_i^2	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1.	480	230400	27.34	747.63
2.	432	186624	-20.66	426.72
3.	456	207936	3.34	11.17
4.	483	233289	30.34	920.69
5.	440	193600	-12.66	160.20
6.	446	198916	-6.66	44.32
7.	414	171396	-38.66	1494.37
8.	468	219024	15.34	235.40
9.	456	207936	3.34	11.17
10.	410	168100	-42.66	1819.63
11.	480	230400	27.34	747.63

Peeling Skin (Using Machine)

12.	432	186624	-20.66	426.72
13.	456	207936	3.34	11.17
14.	483	233289	30.34	920.69
15.	440	193600	-12.66	160.20
16.	456	207936	3.34	11.17
17.	483	233289	30.34	920.69
18.	440	193600	-12.66	160.20
19.	446	198916	-6.66	44.32
20.	414	171396	-38.66	1494.37
21.	468	219024	15.34	235.40
22.	468	219024	15.34	235.40
23.	456	207936	3.34	11.17
24.	410	168100	-42.66	1819.63
25.	480	230400	27.34	747.63
26.	432	186624	-20.66	426.72
27.	456	207936	3.34	11.17
28.	483	233289	30.34	920.69
29.	483	233289	30.34	920.69
30.	440	193600	-12.66	160.20
31.	446	198916	-6.66	44.32
32.	414	171396	-38.66	1494.37
33.	468	219024	15.34	235.40
34.	468	219024	15.34	235.40
35.	456	207936	3.34	11.17
$\sum$	**15843**	7189725		18277.89

a. Data similarity

$$\bar{X} = \frac{\sum X_i}{N} = \frac{15843}{35} = 452{,}66$$

$$\sigma = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N-1}} = \sqrt{\frac{18277}{35-1}} = 23{,}19$$

UCL = $\bar{X} + k.\sigma = 452{,}66 + 2 \times 23{,}19 = 499{,}03$

LCL = $\bar{X} - k.\sigma = 452{,}66 - 2 \times 23{,}19 = 406{,}29$

Grafik 5. 3 Pengupasan Kulit (Menggunakan Mesin)

b. Tes kecukupan data

n (jumlah sampel) = 35
Tingkat Kepercayaan 95%, k = 2
Tingkat Ketelitian 5%, s = 0.05

$$N' = \left[\frac{k/s \sqrt{n(\sum x^2) - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05 \sqrt{35(7189725) - (15843)^2}}{15843}\right]^2 = 4{,}04$$

Karena N' < n, maka data cukup.

c. Menghitung Waktu Standart dan Output Standart

Performance yang digunakan berdasarkan pengamatan dari kegiatan operator.

Performance tersebut adalah :

Kelas	Kode	Nilai
Excellent skill	B2	+ 0,08
Good effort	C1	+ 0,05
Good condition	C	+ 0,02

n (amount of sample)
Level of trust 95%, k
Level of accuracy 5%, s

Good consistency	C	+ 0,01
P1		**+ 0,16**

Jadi besar performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

Then amount of performance (Po = 1) = Po + P1
= 1 + 0,16
= 1,16

While the allowance given by the operator is :

- ❖ Individual need = 2%
- ❖ Factor affecting :
  - Expended power = 9%
  - Work attitude = 2%
  - Work = 1%
  - Atmosphere = 6% +
  - = 20%

Selanjutnya dilakukan perhitungan waktu siklus (Ws) :

Then calculate the cycle time (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

$$= \frac{15843}{35}$$

= 452,66 second

While the normal time (Wn) :

$$Wn = Ws \times p$$
$$= 452,66 \times 1,16$$

= 525,1 second

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 20\%}$$
$$= 525,1 \times \frac{100\%}{100\% - 20\%}$$

= 656,3 second

Then, Standard Output (Os) :

$$Os = \frac{1}{Wb}$$
$$= \frac{1}{656,3}$$

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= 656,3 kg/second

Precentage increase in standard output on old and new machine :

Precentage increase = New tool output = old tool output x 100%
old tool output

$= \frac{0,221 - 0,117}{0,117} X100\%$

$= \frac{0,104}{0,117} X100\%$

= 88 %

Produktivitas Produksi Mesin Lama Pada Biji Kopi yang Sudah Terpisah dari kulit

Productivity of old machine production on coffee beans that have been separated from the skin

Productivity = $\frac{Output}{Input}$

= 0,117 = 0,05 kg/second
2

Produktivitas Produksi Mesin Baru Pada Biji Kopi yang Sudah Terpisah dari kulit

Productivity of new machine production on coffee beans that have been separated from the skin

Produktivitas = $\frac{Output}{Input}$

= 0,221 = 0,11 kg/second
2

Selisih pro

Difference in productivity of old and new machine

= New machine productivity – Old machin productivity

= 0,11 – 0,05

The performance is : ınd

Class	Code	Value

Productivity ratio of Old and New Machine

Old machine : New machine

0,05 : 0,11

1 : 2,2

n operator activities

Conclusion:

The huller machine that separates the dry coffee beans, semi-automatically, can increase production productivity by 0.06 kg/second, and increase standard output by 88% with a productivity ratio of 1: 2.2.

Comparison of Old and New Machines

Based on the data obtained from the old and new machines, it can be concluded as in the table bellow:

:

Perbandingan	Alat Lama	Alat Baru
1. Waktu baku proses pemisahan kulit	169,55 detik/kg	675,45 detik/kg
2. *Output standard* proses pemisahan kulit	0,117 kg/detik	0,221 kg/detik
3. Mutu	Cepat	Lama
4. Proses operasi	Biji kopi yang dihasilkan tidak bisa langsung bersih meski waktunya singkat	Biji kopi yang dihasilkan bisa langsung bersih meski waktunya lama

	Mesin Lama	Mesin Baru
Kelebihan	– Berkapasitas 25 kg dalam sekali proses – Menggunakan diesel sehingga proses penggilingan cepat	– Mudah dipindah karena ukuran yang kecil – Mudah dioperasikan – Tidak meyebabkan kebisingan karena menggunakan motor listrik – Tidak mengeluarkan asap – Dapat memisahkan kulit biji kopi kering dalam sekali proses
Kekurangan	– Sulit dipindahkan karena mesin yang berukuran besar – Proses pemisahan biji kopi lama karena harus melali dua proses untuk menghasilkan biji kopi yang bersih – Mengeluarkan bunyi yang bising dari mesin diesel – Menyebabkan polusi udara dari asap mesin	– Kapasitas yang teralu kecil untuk UMKM menengah ke atas – Kurang stabil dalam pemisahan kulit biji kopi kering

Figure Old Machine

Figure of Coffee Bean Results Using an Old Machine

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Figure of New Machine

Figure of Coffee Bean Results Using a New Machine

So the comparison between the old machine and the new machine is that the old machine has to go through two processes of separating dry coffee bean husks to get clean roasted coffee beans and the engine uses diesel which causes noise and air pollution due to engine fumes. While the new machine in one process can produce coffee beans that are ready to be roasted and use an electric motor that does not cause air pollution and can be moved because of its small size.

CONCLUSION

From the results and explanations of the previous chapters, it can be concluded that the huller machine that separates the dried coffee beans has several advantages and can increase production and operator productivity compared to the old machine. From machine testing, the following conclusions can be obtained:

1. Testing using the old machine obtained a standard time of 169.55 seconds/kg and testing using the new machine obtained a standard time of 675.45 seconds/kg.
2. Testing using the old machine obtained a standard output of 0.117 kg/second and testing using a new machine obtained a standard output of 0.221 kg/second.
3. Based on the test results obtained an increase in production productivity of 0.06 kg/second and a percentage increase in standard output of 88% with a productivity ratio of 1: 2.2.

Suggestion

From the results of the discussion about the huller machine that separates the dry coffee bean skin, the author can give the following suggestions:

1. From the results of the design of the new machine, it is recommended that it be further developed, especially in improving the operator's working time which is still not optimal.
2. It is also recommended to increase the standard output beyond 88% after repair.

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