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Analysis of Manufacturing Process on a Corn Husker, Corn Sheller, and Corn Cob Crusher Machine Method Screw using Motor 0.5 HP

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Corn husker, corn sheller, and corn cob crusher machine, Screw conveyor, cost of goods manufactured.

ABSTRACT

The nutritional value of corn is significantly affected by its planting, harvesting, and processing. corn is one of the staple foods that humans use for food and other items. Typically, corn farmers encounter difficulties during harvest season when ready-to-harvest corn requires a multi-step procedure to obtain corn seeds. Corn is often husked and shelled by farmers using their hands or improvised implements. Research was done on this intricate process in order to build a machine that would crash corn cobs, corn huskers, and corn shellers.. This machine's operation is based on the transfer principle, which involves a screw conveyor that moves from the peeling to the shelling and, ultimately, to the crushing of corn cobs. The manufacturing process analysis of various machine components and the computation of the production cost of manufactured goods are the methods used in this study. The production cost of the manufactured items was determined to be Rp 4,066,919 based on the analysis of the research on the production of the peeling machine, corn sheller, and corn cob crusher. The machine processing time was 11.4 hours.

1. INTRODUCTION

Corn could be a semi-seasonal plant that's more often than not planted some time recently in the stormy season or approaching the summer season. Corn is classified as a monocot herbaceous plant with a single house, where the male blooms develop at the tip (tassel) of the main stem and the female blossoms develop on the side inflorescence (corn cob) that creates on the side of the leaf stem. The classification of corn is recognized based on the shape of the corn parts. [1]. Corn growth can shift based on diverse soil elements, where the composition of soil supplements and the application of fertilizers affect the growth of the planted corn plants [2]. In addition to the previously mentioned parameters, the handling of corn during the collection season moreover requires consideration since corn is the moment's staple nourishment after rice, required as a staple nourishment, animal nourishment, and other processed products. The normal corn generation gotten is 7,405 kg/planting season, or a normal of 5,785 kg/hectare/planting season [3] Not to be ignored within the planting process, fertilization, and sort of land, the preparing of corn generation amid the gathering period is additionally very important, one of which is the drying period of the corn to ensure the moisture content is met, where the moisture substance in high-quality corn is around 14-15%. Other than the corn drying preparation, The capacity process of dried corn seeds can also affect the quality of the corn; hence, extraordinary consideration is needed in storage [4]–[6]

The process of corn gathering is indivisible from the utilization of present-day innovation, where a few elective developments in fabricating innovation within the frame of fitting innovation machines serve as a back for human execution within the current time. A few machine designs utilized in green agriculture for onion crops pointed at increasing nourishment efficiency [7]–[9]. In this consideration, the handling of corn that's prepared for collection will be examined with a few choices that can be actualized, counting the

peeling of corn husks as an exertion to speed up the work of corn farmers. [10]–[12]. Most of the existing machines have distinctive concepts in their forms, with the contrasts by and large lying within the capacity and the shape of the components and edges utilized [13]. Other than the corn husking preparation, another similarly vital preparation is the corn shelling process. There are a few existing options, both single-function and multifunction, where the contrasts in these angles influence the requirement for proficient and less efficient production costs [10], [14], [15]. In expansion, corn cobs can also be utilized as a blend in creature nourishment and charcoal briquettes; hence, a corn cob shredder is also needed. From past investigations, the corn cob shredder can produce 5 kg in 2.5 minutes with a control requirement of 8 Hp [16], [17]. This research effort attempts to create a item a corn peeler, corn sheller, and corn cob chopper, that's multifunctional in a single nonstop handle on a single machine by coordination all of the references that are now available. and a reasonable estimating estimate is gotten by analyzing the fabricating handle. The peeler and thresher knife model has a 0.5 horse power electric motor drive in a screw system.

2. METHODS

The method utilized within the research is the examination of the manufacturing process of the device, as well as the cost examination required within the tool's production. and determining the parameters to be utilized within the design of the device components [18]. The research flow is summarized in the following flowchart.

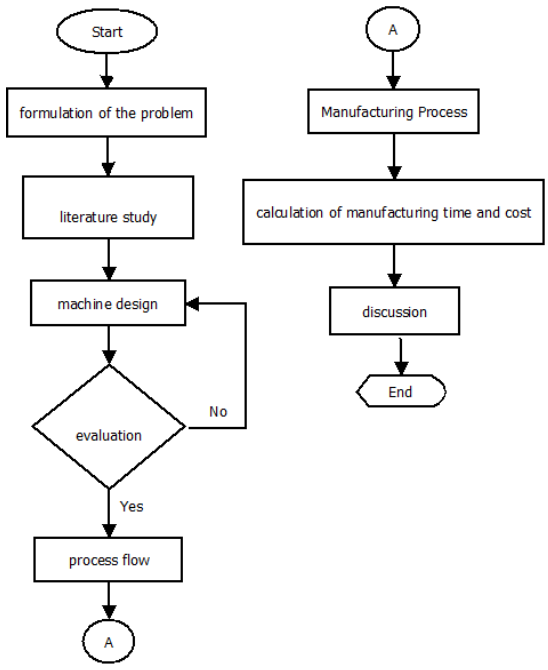

Figure 1. Research flochart

According to the above figure, the first step in this research is to look for literature about farmers' methods for producing corn. The outcome of merging many options found in the field is a tool design that can carry out a number of jobs used by corn farmers, such as crushing corn cobs, peeling corn, and shelling corn. Following that, the multifunctional tool is manufactured, and the last step is to calculate or analyze the cost and manufacturing process of the instrument.

2.1 Definition of the Machining Process

The practice of meticulously altering or producing the majority of materials to create the desired outcome is one kind of machining. A continuous process is needed to develop a machine product, starting with product design, acquiring materials, and then moving on to the next stage, called machining. [19]. The machining process is used to make metal parts for machines; typically, the casting and metal forming

processes provide the raw materials for these parts. The material can be scaled and reshaped using machine tools for operations like cutting and planing.

2.2 Machine Design

The cob chopper, corn peeler, and sheller were created by taking into account variables including manufacturing time and cost. This invention was created in response to farmer demands to speed up the corn harvesting process. The screw mechanism was selected because it takes into account the efficiency and economic worth of the corn peeling and shelling process [20]. The operating method, which is more power-intensive and operates similarly to a screw conveyor, is where the machine design differs from the current machine model. Despite the fact that many of these machines are now multipurpose, each model has unique benefits and drawbacks.

2.3 Understanding Production Costs

Production costs can become an added value that is advantageous and always linked with the amount of money that individuals or groups must spend in order to accomplish a necessary or desirable goal, either now or in the future. The cost of manufacturing the 0.5 HP motor-powered corn peeler, corn thresher, and corn cob crusher includes.

1. Machine depreciation costs (bank interest, taxes, insurance)
2. Direct variable costs (machine operator costs)
3. Indirect variable costs (location rental costs)
4. Machine usage costs (electricity costs, cutting tool costs, and others)
5. Cost of materials

From the above costs, the following data can be obtained [21]

a) Costs during the machining process

$$Cm = Cm\ non\ machine\ x\ tm \quad (1)$$

C_m non machine = Fixed costs of depreciation machining, direct and indirect variables

t_m = Order time

b) Cost of chisels

$$Ce = \frac{(Cotg+Csg+tsg)}{\mathrm{r}} + r.\frac{Codr}{n} + cm + (tsd + tdr) \quad (2)$$

c_{otg} = price of grinding stones

r = number of sharpenings

c_{sg} = operating cost in cm

t_{sg} = balancing time

c_{odr} = sharpening cost

n = how many times the chisel / grinding stone is used

c_m = operating cost in 1 shift

tsd = time install

tdr = time for sharpening operation

c) electricity usage cost

$$Cp = \mathrm{cr} + cm + ce + elektric\ use\ cost \quad (3)$$

cr = cost of equipment preparation

cm = machining costs during the process

ce = chisel cost

d) ordering time

$$tm = tad + tcd + td\,\frac{tc}{nt} \quad (4)$$

t_ad = non-production time

t_cd = cutting time

td = it is assumed the installation of the chisel

$\frac{tc}{nt}$ = machine and equipment setup time

e) Cost of Goods Manufactured

$$Hpp = Cu\ total + Cm \quad (5)$$

Cu_{total} = total machining cost

Cm = Total overall cost of materials and non-machining

In figure 2, the mechanism of the corn husker, thresher, and crushing machine. In section 1, the process is corn peeling, which involves separating the dried corn husk from its contents. In number 2, it is the corn shelling process, which is the separation of corn kernels from the cob. This process uses the same knife as the previous process, which is the corn husking. The method used in this mechanism is to combine peeling and shelling using a special spiral-shaped knife. This aims to maximize the tool's operation so that the corn, which has had its husk removed, will automatically move to the shelling section. And next, the cobs that have been separated from the corn kernels will enter section number 3, where the crushing process will take place, producing fine fibers as a mixed feed ingredient for livestock and others.

Figure 2. Husker, sheller, and corn cob crusher machine design

3. RESULTS AND DISCUSSION

In the production of husker, sheller, and corn cob crushers machine, there are several process sequences and some manufacturing analyses as follows.

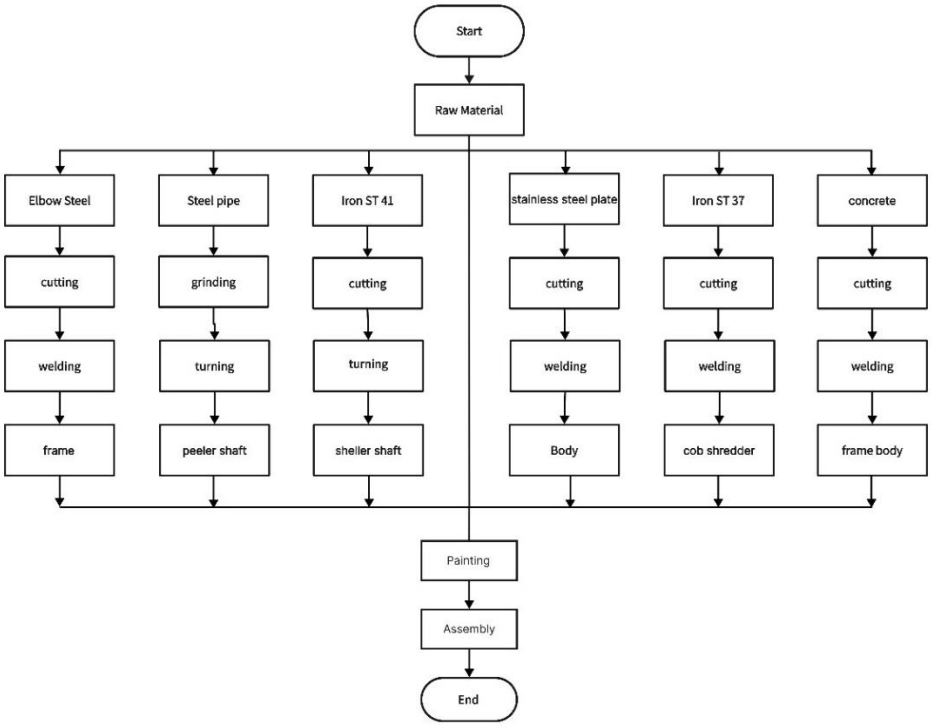

Figure 3. Machine manufacturing process flowchart

In the flowchart above, the processes for making the peeling machine, corn sheller, and corn cob crusher are carried out with several different processes based on their core components.

The first part is the base frame, while the second and third parts are the connecting shaft for the corn peeler and sheller. In the next part, the body of the corn husker and thresher, and the final part, the corn cob crusher and the overall frame.

3.1 Machining process flow

The sequence of the machining process is grouped by each component. Frame component made from 30 x 30 mm hollow steel. The sequence of the required manufacturing process is cutting, then welding. The next component is the outline, just like the previous components, namely cutting and welding. This also applies to the mounting part. However, the difference is in the materials used. Details can be seen in picture 3.

Determination on Types of Manufacturing Processes for Each Component

Table 1. Choosing Production Process Types

Component	Process		
	Turning	Cutting	Welding
Base Frame	-	v	v
Chopper's knife	-	v	v
Body	-	v	v

Table 1 shows that, with the exception of the shaft and roller, every component needs to be cut. On the other hand, welding is not necessary for the shaft and roller parts. The turning process is used to create the shaft and roller. A portion of the necessary items are bought already completed. like motors, shafts, gears, pulleys, and bearings. This machine is made using a machining procedure that minimizes manufacturing costs by using only material cutting and welding techniques. As a finished product, the tool's part that needs to be lathed can be purchased directly.

Results from the Machining Cost and Time Analysis

Table 2. Details of machining costs and time per component

Component	Value (Cp)	Value (Tm)
	Rp/product	Minute/product
Base Frame	987.761	196.8
Choppers knife	393.319	299,6
Body	617.839	187.6

The total production process expenses for each section and the amount of time needed to complete them are shown in Table 2. the highest value in the hollow steel frame-making process, followed by the body-making process in second place, and the knife-making process in last. A total of Rp 1,998,919 is needed for production, and 684 minutes of labor are needed. The frame and body of the machine are given more attention throughout the construction phase since many completed goods are bought in order to use the machine parts. In terms of production costs and time, it is thought to be more cost-effective. And tool design optimization can be accomplished by simplifying the tool's size and frame strength.

Price of Purchased Material Components

Table 3. Details of material component prices

No.	Material	Usage	Specification	Amount	Price (Rp)
1	Angle bar	Mount	3x3 mm	14	180.000
2	Pipe hollow	Peeling Knife	4 inch	2	250.000
3	Motor	Power	½ Hp, 1440 rpm	1	600.000
4	Shaft	Shaft assy	D 25 mm	1	20.000
5	Gear	Transmission	Spur gear 6 in, 68 tooth	2	100.000
6	V belt	-	12,5	1	22.000
7	V belt	-	55	1	62.000
8	Pulley	-	3 in	2	60.000
9	Pulley	-	6 in	1	40.000
10	Pulley	-	9 in	1	90.000
11	Pillow block	mount	205, 25 mm	6	144.000
12	Bolt-Nut	join	19 mm	12	18.000
13	Plat Stainless	Knife	2 mm, 2x2 m	1	200.000
14	Beton eser	knife	8 mm L 1,2m	2	90.000
15	Filler	Finishing body	¼ kg	1	32.000
16	Paint	Body	1 kg	1	40.000

From the table of component and material prices purchased above, it can be stated that the total cost for the purchase of components and materials is Rp. 2,068,000, with the highest price being for the purchase of the electric motor as the driving force of the machine and other supporting components such as the corn peeler and shredder blades made from iron and stainless steel pipes.

From several calculation results obtained during the machine manufacturing process and the finished materials, the production cost of the corn peeler, corn thresher, and corn cob crusher can be determined. HPP = Rp. 1,998,919 + Rp. 2,068,000 = Rp. 4,066,919. Compared to the reference research conducted by Y. Djamalu et all [10], the corn sheller and cutter machine made is more economical and efficient because, in its process, the machine made includes three processes in corn processing. Also in terms of price, this machine is cheaper by Rp. 25,833,081 than that machine. In addition, the use of multifunctional machines in the corn harvesting process is not significant.

4. CONCLUSION

Based on the calculations and manufacturing analysis that have been conducted, to make one unit of the corn husker, corn sheller, and corn cob crusher, it requires a cost of Rp 4,066,919 with a manufacturing time of 11.4 hours. The highest material component costs are the drive motor and the peeling, shelling, and crushing knives. Meanwhile, the highest manufacturing cost for components is the base part with Rp. 987,761. This machine can handle all processes on harvested corn, making it more cost-effective than tools that are available on the market that typically concentrate on just one process, like corn shelling. In contrast,

multifunctional tools are not commonly sold in the market and, when they are, are more costly because of their more intricate and detailed models.

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