DESIGN TO MINIMIZE TIME PRODUCTION FOR REDUCE ENERGY CONSUMPTION ON JACQUARD PUNCHING MACHINE BASED ON GREEN MANUFACTURING METHOD

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Abstract
In the 21st century, the use of machine energy in the industrial world has increased significantly every year. In 2000 the use of electric energy in the world around 13,000 Kwh and in 2015 has reached 22,000 Kwh. In Indonesia energy use by the industrial sector is also quite large, one of them is the textile industry sector. PT. Buana Intan Gemilang is a textile company that produces prayer mats and curtains with a wide sales area. PT. Buana Intan Gemilang has problem in making pattern card by using punching machine, energy use in punching machine is quite big because production process on punching machine using manual process. So it requires an improvement on the use of energy and production time of making pattern card. Green manufacturing is a method that can be used to solve problems associated with waste in the punching machine. The application of green manufacturing method is done in three stages; Identify your color, prepare your brush, paint it green, keep it green. After applying the green manufacturing method on PT. Buana Intan Gemilang energy usage of punching machine was reduced from 33116 Kwh to 8366 Kwh in producing one type of pattern card. Production time also increased in producing one type of pattern from 332 seconds to 83 seconds.

Keywords: Green Manufacturing, Automation, Energy consumption, Production time, Punching machine

1.Introduction

The use of machine energy consumption in the industrial world has increased significantly from each year. In Indonesia energy use from the industrial sector is also quite large. The energy use of textile industry sector in 2014 is 87.252.000 Mwh is quite high compared to other sectors. PT. Buana Intan Gemilang is a textile company that produces prayer mats and curtains with sales area covering Java island. PT. Buana Intan Gemilang has problem in making pattern card by using punching machine, energy use in punching machine is big enough because production process on punching machine still done manually.

At this point the punching machine takes three minutes to create one pattern card which in one pattern requires at least 600 pattern cards for curtains and 2500 for prayer mats. Because the time of making a lot of patterns with a long time to make the company must make elsewhere. Large and long time pattern card making also affect the cost to be spent on the company. It needs a method to reduce energy use and increase the production time of punching machines.

In this research, Green manufacturing will be used a method that can be used to solve problems related to waste in punching machine, especially the use of energy consumption and machine production time. Automation system will be applied to the punching machine as one of the strategies on punching machine method. So that the use of energy on the machine can be reduced as an effort in maintaining the environment and increasing the production time to make the company stay competitive.

2. Literartur Study dan Metodhology

2.1 Green Manufacturing

In Green manufacturing, enviromental impact of all stages of production is consider (Frenky, 2014) . So many things related to the production of e.g. energy use excessive machine because the length of time the production of the machine. Time is money, energy is money and consumables are money. Making the same product using fewer resources and/or energy is a good strategy to make money. Green manufacturing should be viewed as an opportunity to expand the local and global market share in this dynamic environment. A deeper understanding of green manufacturing strategies and techniques will enable manufacturers to realize that unlike other competing manufacturing strategies (like cost and time), being green positively impact all other manufacturing competitive edges. For example reducing material wastes and energy consumption will reduce production cost and improve

production time. Going green in manufacturing will also improve the quality of the production process which will in turn impact product quality and also will be more appealing to the growing number of customers looking for green manufacturers and products.

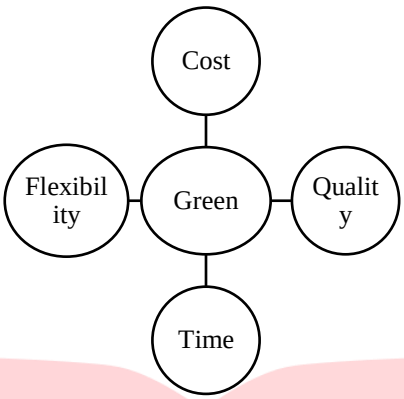

Figure 1. Green manufacturing and competitive manufacturing starategies

Manufacturing operations are energy intensive. All Types of manufacturing process need energy input to actuate machines and equipment to convert raw materials into parts and products. Energy matter in green manufacturig not only because of economic costs added to the products but also because of environtmental impacts associated with the energy production and supply(Dornfeld, David A. 2013)

2.2 Punching machine

Jacquard Punching Machine is machine that designed to cut a hole in some material such as paper, metal, or card stock. There are three basic elements of punching device, a punch, a die, and a stripper. The punch is the piece which is driven through the card and cuts the hole. The die serves as a base, supports the card while it is being cut. 12 drill that is in the middle of punching machine will puncture the card in accordance with the design pattern that has been set on the punching machine engine will make the pattern from the top to the bottom of the card patterns. When the process of making pattern card has been completed, we can draw the lever to the right to return the card to the initial position.The product results from a punching machine is a jacquard card pattern. Rectangular pattern cards have a width of 35 cm and panjan 100 cm. Pattern cards will be formed a small hole pattern. Pattern cards will be formed a small hole pattern. A small hole consisting of 100 barrels per line there are 12 holes to be adjusted to the pattern you want to make. 100 lines are divided into three parts, each section consists of 33 lines.

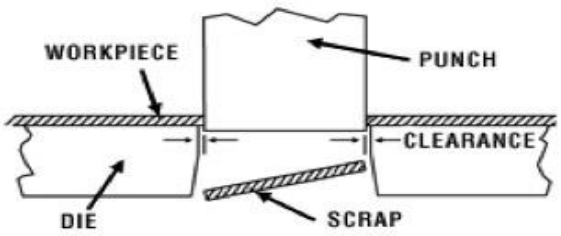

Figure 1. Punching peocess

2.3 Green Manufacturing Method

Green manufacturing design that will be implemented in textile company PT.Buana Intan Gemilang consists of several stages. Design green manufacturing clarify every step that needs to be done in implementing in company. There are four stages: Color identification, prepare your brush, paint it green and keep it green. Green manfacturing design will be implemented in PT punching machine. Buana Intan Gemilang.

a. Stage 1: Color Identification
   The process of color identification in PT. Buana Intan Gemilang was doing by questionnaire method that distributed to some operator of jacquard punching machine. This process is done to find out the current state of the company, so it can easily determine what actions can be take. Questionnaires distributed to 5

operators of punching machi'ne that really know the condition of machine and company , the questionnaire template can be seen below:

Tabel I. Result of weighting questionnaire

Weight Calculation	Weight	Average	Rank
1	1,8	2,13333	2
2	2,4		
3	2,2		
4	3,2	3,125	1
5	3,4		
6	3,2		
7	3		
8	3,2		
9	3		
10	3		
11	3		

Rank	Object	Weight	Persentage
1	Material	2,13333	41%
2	Energy	3,125	59%
Total		5,25833	100%

If the company fall into the category of black, brown, or gray it would require an improvement strategy on the company to increase the color category into the green category. Tools used in identifying the green color in the company can use green streaming mapping, questionnaire, and impact analysis. Kuisinoer is a quantitative method used in this study to identify the color of the company. Quizononer will be given to operators at PT.Buana Intan Gemilang. Then each question will have a certain weight that will be calculated and become a way in determining the color of the company based on the results of the questionnaire.

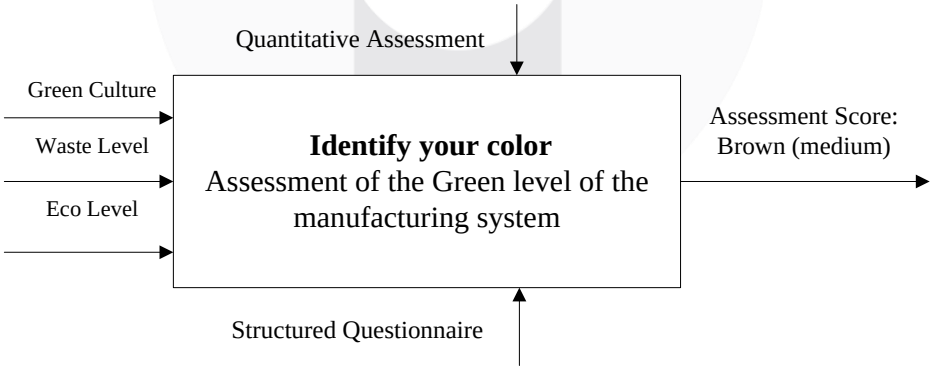

Figure 4. Model for identification color

b. Stageb 2: Improvement Object

Improvement object is to determine the object to be improved in order to improve the color of the company from brown to green. Object to be improved is the use of energy and production time of the punching machine PT. Buana Intan Gemilang. Increasing the production time of a punching machine aims to optimize the process in order to minimize energy consumption. Optimal process by minimizing energy consumption indirectly will save company expenses and increase the capacity of punching machine.

Fiure 5. Model for green improvement

c. Stage 3: Green Implementation

Green implementation is the stage of implementing all planned strategies against punching machines. Automation technology applied to punching machines will be measured based on changes in production time and energy consumption of punching machines. If the automated punching machine has faster production time and less energy consumption with a production amount that can meet the targets that have been made by PT.Buana Intan Gemilang

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Figure 6. Frame work automation system

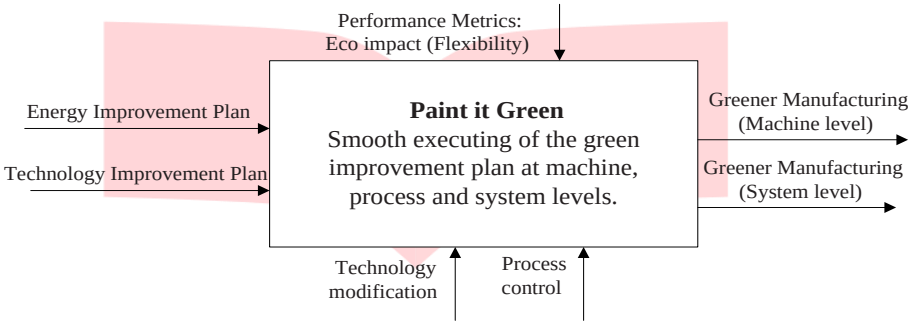

Figure 7. Model for green implementation

d. Stage 4: Keep it Green

The last step is keep it green where green manufacturing realization should have sustainability as in an inherent component in any green planning activity. the expected output at this stage is some green manufacturing policies and guidelines on the operation of the machine. Some trainings conducted to educate operators on how to maintain the achieve improvements and also creation of standard work to sustain improve paint performance.

3. Result dan Pembahasan

3.1 Calculate energy ac motor

Konsumsi energi pada AC Motor mesin punching :

Tabel II. Spesification ac motor

Nama Motor	P(kW)	V(v)	I(A)
Pompa motor ZD1200627	55	380	134,2

Tabel III. Ac motor 3 phasa

Nama Motor	Fasa	V(i-i)	if(A)	Cos □	μ
Pompa motor ZD1200627	R	387	112	0,86	0,95
	S	385	118		
	T	385	113		

By calculating the load as the ratio between input power (measured by power analysis tool) and power value at 100% loading. For a three phase motor, the step is to determine the input power with the following equation

$$\text{Pi} = \frac{\text{V} \times \text{I} \times \text{Cos}\,\phi \times \sqrt{3}}{1000}\ kwh \text{.....(1)}$$

Pi = daya tiga fasa (kW)

V = arus (V)

I = arus (A)

$$\text{Pi} = \frac{385{,}67 \times \text{I14} \times \text{Cos } 0{,}86 \times \sqrt{3}}{1000}\ kwh$$

Pi = 49,7993

Then determine the value of incoming power at full load.

$\text{Pr} = \frac{\text{P}}{\eta_r}\ kwh$.....(2)

where :

Pr = Power goes at full load (kW)

P = daya (kW)

η_r = Efficiency is full load

$$\text{Pr} = \frac{75}{0{,}95}\ kwh.....(2)$$

Pr = 78,9474

Then calculate the load in%

$$\text{Load} = \frac{\text{P}i}{P_r} \times 100\%$$

dimana :

Load = Output power expressed in% nominal power value

$\text{Load} = \frac{49{,}7993}{78{,}9474} \times 100\%$

Load = 63%

After measuring the current and voltage, as well as calculating the power input motormaka can be calculated estimation of electrical energy consumption for each motor.Didapatkan insert power (Pi) and motor operating period every day is for 8 hours, then estimation of daily electrical energy consumption using equation.

W = P × t

dimana :

W = Changes in electrical energy (kWh)

P = Power used (kW)

t = interval (hours)

Motor Load = 75 kW x 63%

= 47,3093

$$W = P \times t....(3)$$

= 49,7993 × 8 hours

= 398,3942967 kWh

3.2 Calculate consumption and production time machine punching.

Automation system design successfully implemented at punching machine and automation system running as expected for reducing the processing time and so can reduce consumption energy. The machine can operate at the same time but with more production. So companies can be better prepared to demand new patterns for making prayer mats and curtains. Reduction of processing time would increase production capacity so that the reduce consumption energy.

The following is a calculation of consumption energy in one year :

Tabel IV.3 Production time and energy cosumption

Production Machine Punching Before In automation		Production Machine Punching After In automation	
Total Card Patterns required (pcs)	7195	Total Card Patterns required (pcs)	7195
Production time to create one pattern card (sec)	323	Production time to create one pattern card (sec)	83
Time per day / second	25200	Time per day / second	25200

Production Results / day	76	Production Results / day	296
Total days required	95	Total days required	24
Total Energy needed (Kwh)	33116	Total Energy needed (Kwh)	8366

The results show a significant difference in the production time of the punching machine after and before using the automation system. The average punching machine's production time in a day is 83 seconds. The increased production time is directly proportional to the product yield. The average production of punching machines is 76 pcs. The time and amount of increased production can have a positive impact on the company

3.4 Analysis of automation impact to green manufacturing

The automation system used in the green manufacturing method is part of the strategy to improve the greed color of PT. Buana Intan Gemilang. Impact success of automation system technology on punching machine can be measured by the result of change of production time and number of pattern card production on punching machine that can be produced. Figure V. Production time describes the comparison of production time of the punching machine after using the automation system.

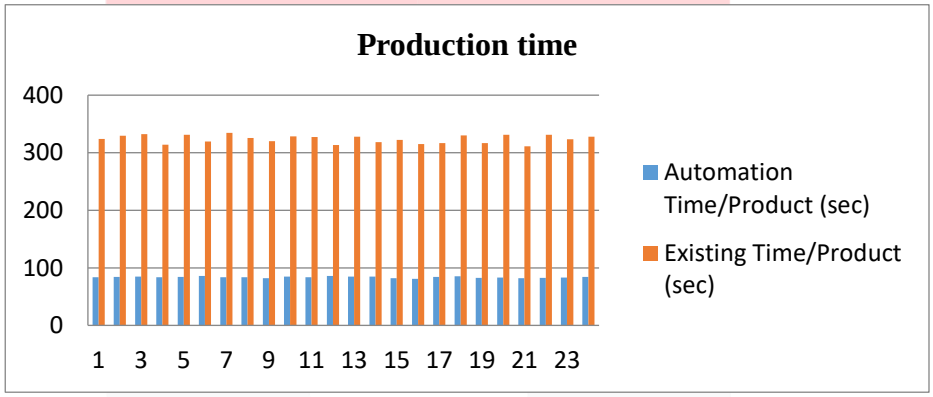

Figure V.2 Production time/Pcs

The result of the V. Production time image shows the time of the punching machine before the automation system is applied. The average production of one pattern card in a day is 300 - 350 seconds. Meanwhile, after implementing the automation system on the average punching machine production time per day is 79 -84 seconds. A significant difference in the production of punching machines can be due to the technology used in the punching machines before being automated is a technology in 1986 where the hole creation on the pattern card was manually ejected by pressing the needle on the machine. Inversely proportional to the automated punching machine the needle moves automatically according to the pattern in punching the pattern card.

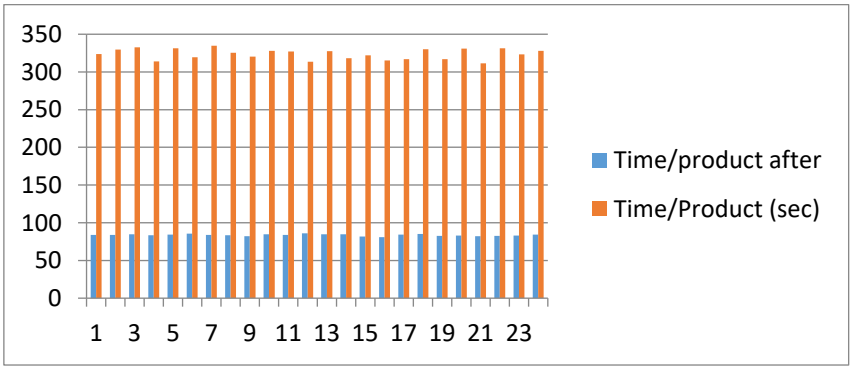

Figure V. 3 Product/day chart

Based on figure V.3 time product chart production time in making pattern card on punching machine in one day. Red bar mennggambarkan number of punching machine products that have been using automation. One day punching machines can produce average pattern cards for 332 pattern curtains. This means for one type of pattern curtains only takes two days. While the blue bar merupkan number of products that can be produced in a day by a punching machine that has not been automated. Automation engines that have not been automated in a day produce an average of 77 cards. This means to complete one type of punching machine curtain pattern takes one week.

4. Conclution

The application of green manufacturing method of energy use of punchinng machine can be reduced according to the purpose of research. One of the technologies used in PT punching machines. Buana Intan Gemilang change brown color to green manufacturing is automation technology. The outputs resulting from the implementation of the automation system are:

1. The production time of a punching machine can make pattern cards faster than 332 seconds to 76 seconds
2. Increased punching machine production capacity makes it easier for companies to deal with demand fluctuations from 74 cards per day to 332 cards per day
3. Energy consumption of smaller punching machines in producing pattern cards from 33116 Kwh to 8366 Kwh

Impact is quite significant for companies that apply the method of green manufackturing. Because green manufacturing is a method that is being developed to reduce the destruction of natural resources and environment due to industrial activity in the world.

Daftar Pustaka

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