DESIGNING OF CARTON BOX STACKING TOOL TO INCREASE THE EFFICIENCY OF POND MACHINE AT PT. SUPREME TIRTA LARISINDO

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ABSTRACT

PT. Larisindo Tirta Agung is one of the companies that produce carton box. Production of carton box carried out using pond machine. The problem faced by PT Tirta Agung Larisindo today is the difficulty in stacking of carton box after the process of pond. The current condition of carton on the table are disorganized and causing discomfort of operators. Operators should be tidy it up before placed on the end stack, causing inefficiency of pond machine in the production process. These problems can be solved by using a stacking carton box tool, because by using this tool, no tidying activities. Stacking tool has been designed based on Indonesian people anthropometric data, thus comfortable in using it. Based on data of tool implementation, by using this tool, pond engine efficiency become increased 17.53%, which was originally 64.28% to 81.81%. The capacity of production increased from 7480 become 10750 pieces of sheet in a day at one work station.

Keywords: Company Carton Box, Carton Box Stacking Tool, Efficiency Machines Pond

1. INTRODUCTION

In the carton box production process there are some machines that are used, one of which is a pond machine. In this work station, problems that occurred are that the carton box after the process pond, carton box when it stacked irregular and uncomfortable occur due to too high a carton box when stacked continuously. In the production process at work stations pond machines, operator have four main activities, that is the completion of which will be pond, doing the process of pond, trimming the results, and put the results on the groomed stack already. With in doing four activities, we found that the process of carton box trimming is an activity that is not needed, causing inefficiency of pond engine, resulting in lack of production capacity of the machine pond. Based on the description above we do designing of the device that make a groomed carton box after the process pond to improve the efficiency of the machine, as well as the company expected and get the optimal production capacity on the a pond work station machine.

2. LITERATURE REVIEW

Work Chart is a tool that describes the activities in a systematic and clear. With this chart we can obtain the information needed to improve a system work (Sutalaksana, 2006). One type of chart is a worker-machine chart. This chart illustrates relationship between cycle time of the operator (worker) and the operating cycle of the machine or other work facilities are handled by the worker. Worker-machine chart also describe the coordination or the relationship between working time and idle cycles of a combination of the operator/worker and the machine. Accordingly, this chart would become a good analytical tool to reduce idle time. The most important information obtained from the worker-machine is a clear relationship between the operator work time and the work cycle time of operation.

Quality Function Deployment (QFD) is a planning tool which is be used to fulfill the expectations of the operator. QFD approach focuses on product design, engineering, productivity and providing in-depth evaluation of a product. An organization that implements proper QFD can improve engineering knowledge, productivity and

quality, reducing product development time and engineering changes in line with advances technology and the operator demand (Cohen, 1995). The purpose of QFD is to meet the expectations operator as much as possible, and strive to exceed those expectations by designing a new product.

Morphological Chart may help the product designers to identify new combinations of elements or components of the product. Morphology means the study of the shape / form. Morphological analysis is a systematic attempt to analyze the forms of the product (DM. Ratna Tungga Dewa, 1999). Meanwhile morphological chart is a summary of the analysis. This chart may formulate the complete elements, components, or sub-solutions it can be combined to obtain a solution. The solution obtained of which is possible combinations, it can be an existing solution, or a totally new variations.

Analytical Hierarchy Process (AHP) is a good method to choose the activities that competes or many alternatives based on certain criteria. The criteria may be quantitative or qualitative. AHP was developed by Thomas L Saaty is a functional hierarchy model with the main input of human perception (Saaty, 1988). The presence of hierarchy, or unstructured complex problem is divided into sub-sub-problems and then compiled become a form of hierarchy. AHP has the ability to solve multi-criteria problems based on the comparison of the preferences of each element in the hierarchy.

Ergonomics is derived of the words in Latin Ergos that means working and Nomos which is means that the laws of nature. The definition of ergonomics can be described in a focusing, objectives, and the approach of ergonomics where the explanation is mentioned as follows:

1. Ergonomics focuses on human interactions with the product, equipment, facilities, procedures, and environments where human daily life and work.
2. The goal of ergonomics is to increase the effectiveness and efficiency, improved safety, reduced fatigue, and so on.
3. Ergonomics approach is the application of information about human limitations, capabilities, behavior characteristics and motivation to design procedures and the environment in which human activity daily.

Based on the above three approaches, it can be concluded that the definition of ergonomics science to explore and apply the information about human behavior, abilities, limitations and other human characteristics to design the equipment, the machine, systems, and work environments to improve productivity, safety, comfort and effectiveness human work. Ergonomics can also be defined as a branch of science that systematically utilize information about the nature, human capabilities and limitations to design a working system thus people can life and work on the system finethat is to achieve the desired goal through the job effectively, safe and comfortable (Nurmianto, 1998).

3. RESEARCH METHODOLOGY

The research was conducted by interview and questionnaires to the 12 pond machine operators, then do the designing the product based on the data that has been obtained. After obtaining the design, researcher create a prototype and implementing directly by comparing the efficiency conditions of the initial work stations without the use of tool and after using the tool.

4. RESULTS AND DISCUSSION

Carton cutting process in PT Tirta Larisindo by using a pond. There are two pond machines work station, which has a daily production capacity of 7480 carton box in one work station, with working hours for 8 hours a day. Within doing cutting machines pond faced with the difficulties in stacking carton after the cut, causing less efficient machines pond. Because the machine is not efficiently cause production capacity becomes less optimum.

At present, in conducting the pond process, there are four activities in the

process, consist of prepare the material for the pond, pond process, arrange the carton after the process of pond, and put the the carton that has been tidy into a stack. The presence of the machine inefficiency, then made a solution by analyzing the work station. The objective is to obtain the machine to be more efficient so as to increase the production capacity of the company. Here's a picture of work station conditions without using the tool:

Figure 1. Carton box stacking (low position)

Figure 2. Carton box stacking (high position)

Figure 3. *Carton Box* Sort-outing

Figure 4. *Carton Box Positioning*

Based on field observations, created work chart as described in Table 1.

Table 1. Worker-Machine Chart (Current condition)

WORKER-MACHINE CHART

Job : Carton Box Cutting
Machine : Pond Machine
Worker : Mr. Yanto
Chart No :
Current : V Proposed :
Created by : Lamto Widodo, Silvie Ariyanti and Alvin Khumara
Date : 29 October 2013

WORKER			POND MACHINE		
Activities	Time (s)		Activities	Time (s)	
Compile material for pond	100		Delay	100	
Doing the pond	540		Cutting	540	
Carton already pond, be made up	180		Delay	180	
Bringing into the carton stacks already in pond	20		Delay	20	

	Worker	Machine
Delay time	-	300
Working time	840	540
Total time	840	840
Persentage of usage time	100%	64.28%

Based on the data that is obtained, then do design of carton box stacking tools with attention to the ergonomics to achieve operator comfort. This stacking tool able to

move up and down with flexibility adapts to the cartons load that will be placed upon that instrument. Based on the data table of Indonesian people anthropometry, the height of carton stacking tool box is 932 mm (when empty) according to the height data value of 5% percentile male elbow. Whereas when carton stacking device has a loads, the maximum height is 125 mm size, according to the height data value of 5% percentile male shoulder. On the right and left carton box stacking tool are also given cavity for ease in lifting the carton box already accumulated on the tool. The dimensions of the hand cavity is 100 mm, using the data of 95% percentile male hand and made quite large up to 100 mm in order to be more convenient in lifting the carton box. The following picture shows the product carton box stacking tool:

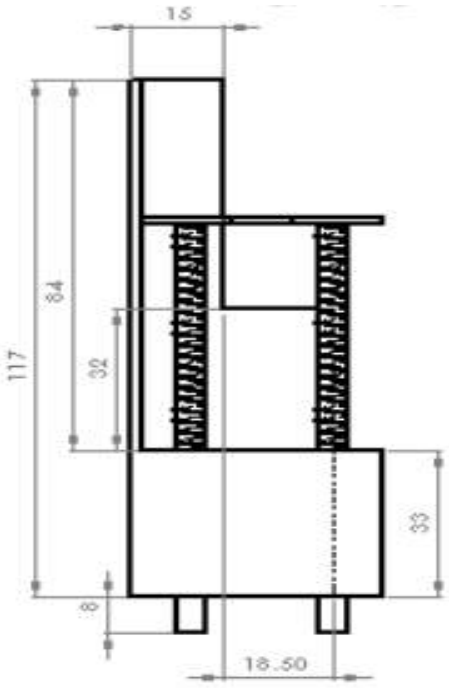

Figure 5. Front View

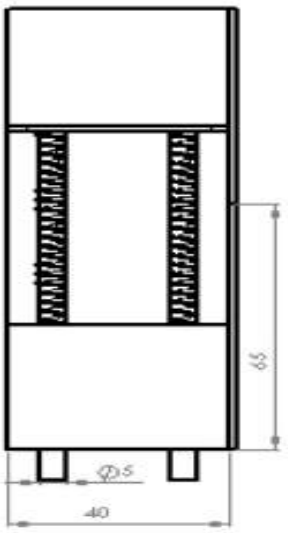

Figure 6. Side View

Figure 7. TopView

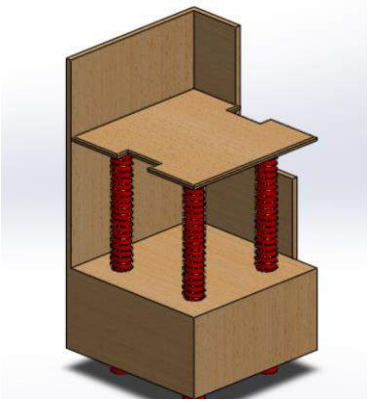

Figure 8. Three dimensional shape

Based on the real problems in the company, then performed the design of tool at the work station by considering pond machine operator desires. Operator desires are listed in the QFD table. The following table is the result of QFD and will be use to design of the tool of carton box stacking machine at the pond work station :

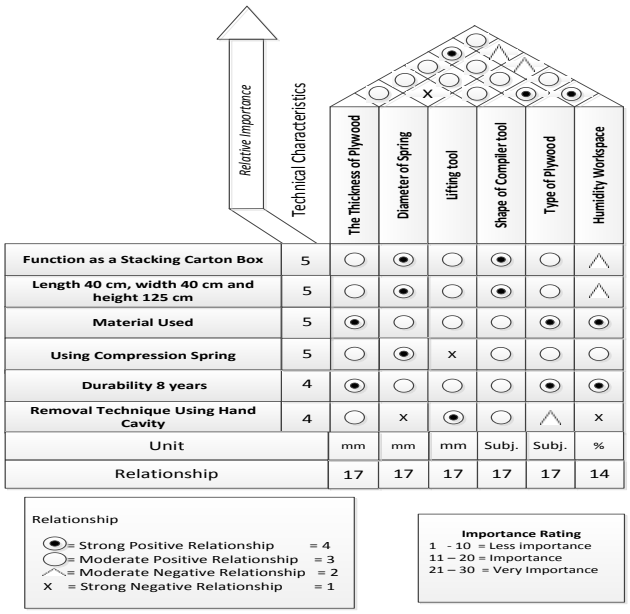

Figure 9. Quality Function Deployment of Carton Box Tool

After conducting research on operator's preference, then based on that desire be made several alternatives with morphological charts. Here's an alternative material, spring, color, and durability for carton box stacking tool, can be seen in Table 2.

Table 2. Morphological Chart of Carton Box Stacking Tool

No	Characteristic	*Means*		
		1	**2**	**3**
1	Material	Steel	Plastic	*Plywood*
2	Spring	Compression Spring	Tension Spring	Hidrolic Spring
3	Method of Lifting	Compression	Pallet	Clearance
4	Durability/Useful Life	12 years	10 years	8 years

Alternative 2 | Alternative 1 | Alternative 3

Based on the above 3 (three) alternatives, an weighting assessment by using Analytical Hierarchy Process (AHP). AHP results show alternative 3 be the best alternative with value 4.5, so it can be realized by creating a real products. AHP assessment results can be seen in Table 3:

Tabel 3. AHP Table for Carton Box Stacking Tool

No	Evaluation Criteria			Alternative 1			Alternative 2			Alternative 3		
	Objective	Wt	Parameter	Descrip	Value (v)	Wt.v	Descrip	Value (v)	Wt.v	Descrip	Value (v)	Wt.v
1	Material	0.17	Conformity	Fair	3	0.51	Fair	3	0.51	Very good	5	0.85
2	Spring	0.60	Conformity	Fair	3	1.80	Poor	2	1.20	Very good	5	3.00
3	Method of Lifting	0.05	Contrast	Good	3	0.15	Good	2	0.10	Very good	5	0.25
4	Durability	0.17	Useful Life	Good	4	0.68	Good	5	0.85	Fair	3	0.51
Total					**13**	**3.14**		**12**	**2.66**		**18**	**4.61**
Average					**3.25**			**3.00**			**4.50**	

The design tool is realized in the form of the drawing based on anthropometric data, then performed the prototype. The following figure shows a prototype of carton box stacking tool.

Figure 10. Front View

Figure 11. Side View

Figure 12. Top View

Figure 13. Back View

Carton box stacking tool that has been be made, implemented at the the factory pond to obtain the efficiency of the machine after using the tool. Folowing picture shows the workstation by using a tool.

Figure 14. Carton box stacking (low position)

Figure 15. Carton box stacking (high position)

Figure 16. Carton Box Positioning

Based on the data implementation taken at PT Tirta Agung Larisindo, the time required by the operator to perform a time period from the beginning of taking carton to put in a stack of carton, where an average a period of pond machine produces 250 sheets carton. Spring will decrease by 18 cm maximum on the number of carton weighing as 125 sheets of 5.4 kg. By using this tool box carton, can be made a new worker-machine chart, according to the field data. Worker-machine chart can be seen in Table 4.

Based on time data hass been described on the worker-machine chart, pond machine time during the period of 660 seconds (about 11 minutes), can produce 250 pieces of carton box. A comparison results of production before and after using the tool can be seen in Table 5.

Table 4. Worker-Machine Chart (New/Proposed)

WORKER-MACHINE CHART

Job : Carton Box Cutting
Machine : Pond Machine
Worker : Mr. Yanto
Chart No :
Current : V Proposed :
Created by : Lamto Widodo, Silvie Ariyanti and Alvin Khumara
Date : 29 October 2013

WORKER		POND MACHINE	
Activities	Time (s)	Activities	Time (s)
Compile material for pond	100	Delay	100
Doing the pond	540	Cutting	540
Bringing into the carton stacks already in pond	20	Delay	20

	Worker	Machine
Delay time	-	120
Working time	660	540
Total time	660	660
Persentage of usage time	100%	81,81%

Table 5. Comparison results of production before and after using tool

Variabel	Befor Using Tool	After Using Tool
Time	840 seconds (14 Minutes)	660 seconds (11 Minutes)
1 stack	220 sheet	250 sheet
1 day	480 minutes : 14 minutes = 34 stack	480 minutes : 11 minutes = 43 stack
Capacity	34 x 220 sheet = 7480 sheet	43 x 250 sheet = 10750 sheet
Efficiency	64.28%	81.81%

After implementation using tool, the results obtained by the company at the pond machine work station increased from 7480 become 10750 pieces of sheet in one working day for 8 hours. And engine efficiency pond increased become 81.81% which previously just a 64.28%.

5. CONCLUSION

Improvements on pond engine work stations can be performed by adding a stacking tool carton box, which is adapted based on anthropometric data of Indonesian society. Analysis of the tool box carton stacking is done directly on the the implementation of the factory and the results obtained is the efficiency of the engine increase 17,53%, which was originally 64.28% to 81.81%. The production capacity of PT Tirta Agung Larisindo increased from 7480 sheets a day (without tool) and become 10750 a day by using a tool.

6. REFERENCES

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