

IMPACT ANALYSIS OF IMPLEMENTATION OF AUTOMATION TECHNOLOGY ON REFRIGERATOR OUT DOOR FORMING PROCESS IN ELECTRONICS COMPANY TANGERANG

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Abstract

This research is conducted at an electronics company in Tangerang which produces a refrigerator with an average production capacity of 5,500 units per day. To improve productivity in the manufacturing process at the company has done several automation processes in several workstations that allow automation processes. Takt time reduce from 12 seconds to 8.5 seconds and the number of operators 80% decreased from 10 operators to only 2 operators. It also has the effect of reducing the possible risk of accidents for operators. Automation processes using robots have advantages in terms of process stability and ease in the adjustment of motion, making it particularly appropriate in automation processes in the manufacturing process industry. That is based on analysis conducted by using SWOT analysis method.

Keywords: automation, productivity, robot, SWOT, takt time.

1 Introduction

Management for line production in manufacturing industry very important to improve productivity and quality to optimize quantity and quality result, also lead time base on customer order.

Base on company target to reduce manpower and to increasing efficiency, at the Manufacturing Industry has implementing automation on Out Door Forming process for refrigerator assembling in production process. The automation process by replacing the work pattern of the manual process by using human labor (operators) by employing 10 operators become a process that uses automation technology by robots that 2 people for operating.

To find out the level of success of the implementation of the automation technology, a research was conducted to analyze the impacts produced in terms of productivity and quality of the work station.

2 Literature Review

Productivity is a measure that states how well resources are regulated and utilized to achieve optimal results (Rohith, et al., 2018). Productivity is a benchmark for the success of an industry or SME in producing goods or services (Sedlacek, 2013). The higher the ratio, the higher the product produced. The productivity cycle is one of the productivity concepts that address efforts to increase productivity continuously. There are four stages as a cycle that is connected and unbroken (Gaspersz, V. 2000); measurement, evaluation, planning, Improvement.

Productivity that is taken into account is only a good product that is produced, if a work station releases a lot of defective items, it can be said that the work station is unproductive (Colomo, et al., 2014). The four activities mentioned above have become the basis of the industry in increasing productivity. The productivity cycle is used as a basis for improving production problems, especially at the industrial scale (Sivakumar et al. 2012).

Takt Time is the time available to produce each product unit to meet customer demand (Wang, et al. 2011). Thus, management who handles production must arrange the process according to the specified takt Time so that the number of units produced is in accordance with the number of units needed by the customer. Cycle

Time is the time needed to produce a product unit from the beginning of the process to the most recent process (Dickerson, et al., 2015). To achieve the number of units requested by the customer, the cycle time must be lower or equal to takt time. The main difference from cycle time and takt time is: takt time measures customer demand while cycle time about process / work circulation (Swenson, et al. 2016). To meet the demand (Takt Time), it is necessary to increase the cycle time. Lead time is the waiting time starts when a request is made and ends when sending (Lin, et al. 2012). The lead time will start when the work starts on request and ends when the item is ready to be sent. In the sense that in short, Lead Time is what customers see. Meaning Lead time is the average time for a product unit to flow throughout the process from beginning to end including waiting time or waiting time between sub-processes.

Each company engaged in the production of goods, most of them will use lean manufacturing (Chavez, et al., 2013). Lean is an effort made by a company to prevent and eliminate waste so that it can increase the added value of products for consumers (Hallam, 2016). This lean concept will be clearly illustrated in the field at the level of added value to waste. Waste must be eliminated to increase income every month or want to increase capital in the industry or company (Sertyesilisik, et al., 2016).

Automation is a technology application that is carried out or targeted as a mechanized application, so that in its application automation can have a positive impact on the activities carried out (Cline, et al., 2013). Automation is the process of automatically controlling the operation of a device that can replace the human role to observe and make decisions (Pidd, 2010). The current control system has begun to shift to the control system automation, so human intervention in controlling is very small. Automatically controlled equipment system is very easy when compared to manual systems, because it is more efficient, safe, and thorough (Valid, et al., 2010).

The use of automation processes in industry generally has a reason (Ghazizadeh, et al., 2012); Increase company productivity, high labor costs, lack of labor for certain abilities, workers tend to move to the service sector, Labor safety or safety against production operations, The high price of raw materials, the efficient use of automation will save and reduce the number of failed products or scrap, Improve product quality, lowering "Manufacturing Lead Time", lowering "in-process inventory", educing the high price of products before automating.

To obtain this information we can use SWOT analysis which has proven effective in evaluating strengths, weaknesses, opportunities and threats in planning an automation project (Knorst, et al., 2011). Using a SWOT analysis can identify internal and external factors that are supportive and which are not in achieving these goals. SWOT analysis can be used by analyzing and sorting out things that affect the four factors (Kalali, 2016), then applying them in the SWOT matrix image, to describe how the power can take advantage of the opportunities, how to overcome weaknesses that hinder the opportunities existing, then how to deal with existing threats, and how to overcome weaknesses that can create real threats (Wenjing & Lun, 2014).

3 Method

This study was focusing on a station Out Door Forming process that making out door sheet a part of door for refrigerator which had been changed from manual work that using human labour and replaced by using an automation system by robots. Observe method by direct observation in station process, measurement of takt time by stop watch and data history of production result. The data to be analyse using formula from literature and also analyse using SWOT method to analyse about feasibility the automation implementation.

4 Result and Discussion

Manual to Automation Improvement

In this study, research was carried out before and after changes in the layout and work processes of Out Door Forming process.

a. Manual Out Door Forming Process

Layout of the work process manually, there are 4 press machines and there is a process of transferring process material from input materials to finished goods stored in the lorry carried out by 10 operators by generating an average takt time 12 seconds. The layout and actual layout of the manual process can be seen in Figure 1.

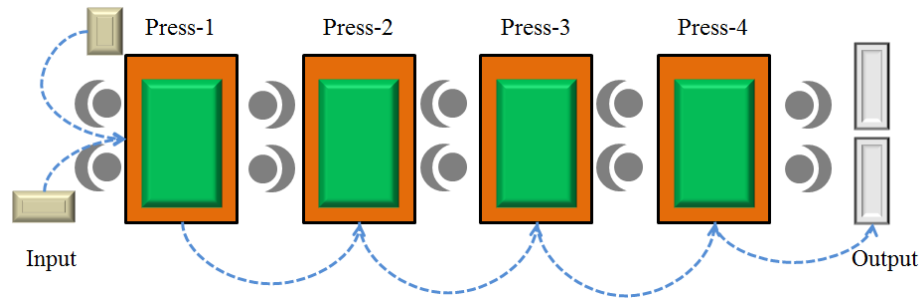


Figure 1 Layout manual out door forming process.

The work process of transferring sheet material by operators, where there are two operators between the press machines that work to move material from the previous press process to the next press process.



Figure 2 Manual work process by operators.

b. Automation Out Door Forming Process.

In the work process after automation, the press machine still uses the same machine as before the automation changes, the difference is in the process of transferring production material from input material to the press process on the press machine to finished goods (output) using robots as the core of the automation process. And there are 2 operators to move finished goods from the output conveyor from the press process to the storage lorry. Takt time generated from this automation process is 8.5 seconds.

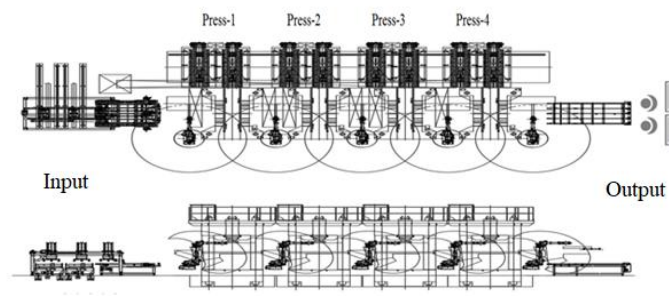


Figure 3 Layout automation out door forming process by robots.

The work process of transferring production material automatically using a robot at the Out Door Sheet process can be seen in Figure 4.



Figure 4 Work process automatically uses robot.

Takt Time & Unit Per Hour (UPH) Result

Based on the measurement of takt time, obtained 2 (two) data, the data is takt time manual process data and takt time process using robots (automation).

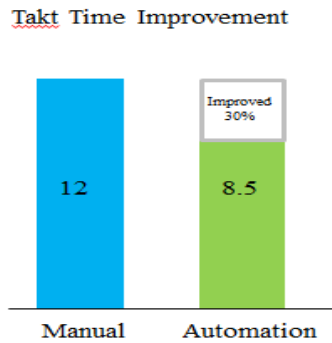


Figure 5 Takt time before - after automation.

Measurement results takt time data for manual process is 12 seconds and automation process by robot is 8.5 seconds, the difference of the process is 3.5 seconds or has a 30% improvement. From the results of the takt time, we can calculate for productivity unit per hour for each process and the result as Table 1.

Table 1 UPH result each process

Process	Takt time	Result/hr
Manual	12	300
Automation	8,5	424

From Table 1 it can be concluded that there is an increase in production every hour by 41%, So that with the use of automation it can increase productivity.

SWOT Analysis

To determine the feasibility of applying automation to the process of Out Door Forming process, the research also analyze using SWOT methods.

Strengths

- Impact *takt time* from 12 second to be 8.5 second, productivity will increase 40%.
- For material transfer process reduce man power 10 persons to be 2 persons, 80% improved.
- By using robot, process stable and can eliminate injury for employees.

Weakness

- Cost for investment so high, ROI 6 years.
- Have to spend expense for robot maintenance.
- Electricity increase.

Opportunity

- Actually the wage system is increasing every year, the stability of the wage process for labor is good impact.
- Flexibility for increasing capacity for production quantity.
- Lead Time impact is good.

Threats

- Reduce employment opportunities.
- Possibility of a robot being breakdown, disrupt the production process.
- Skill up for employee about robot system by training.

SWOT Matrix

Table 2 Internal factor analysis - strength strategy

Strategic Factor	Weight	Rating	Score
Productivity Increase	0,4	4	1.6
Reduce Man Power	0,3	3	0.9
Risk Injury	0,2	2	0.4
Reduce Defect	0,1	2	0.2
Total Score	1	11	3.1

Weight:

- 0,1 = Less Important
- 0,2 = Somewhat Important
- 0,3 = Important
- 0,4 = Very important

Rating:

- 1 = Less Strong
- 2 = Somewhat Important
- 3 = Strong
- 4 = Very Strong

Table 3 Internal factor analysis - weakness strategy

Strategic Factor	Weight	Rating	Score
High Investment	0,3	-1	-0,3
Maintenance Cost Increase	0,1	-3	-0,3
Electricity Cost Increase	0,1	-3	-0.3
Total Score	0,5	-7	-0,9

Weight:

- 0,1 = Less Important
- 0,2 = Somewhat Important
- 0,3 = Important
- 0,4 = Very important

Rating:

- 1 = Less Weak
- 2 = Somewhat Weak
- 3 = Weak
- 4 = Very Weak

Table 4 External factor analysis - opportunity strategy

Strategic Factor	Weight	Rating	Score
Wage stable	0,3	3	0,9
Production Plan vs Employee stable	0,3	4	1,2
Lead time Good	0,2	3	0,6
Total Score	0,8	10	2,7

Weight:

- 0,1 = Less Important
- 0,2 = Somewhat Important
- 0,3 = Important
- 0,4 = Very important

Rating:

- 1 = Less Weak
- 2 = Somewhat Weak
- 3 = Weak
- 4 = Very Weak

Table 5 External factor analysis – threats strategy

Strategic Factor	Weight	Rating	Score
Reduce employment opportunities	0.1	-1	-0,1
Machine Breakdown	0,3	-2	-0,6
Skill up employee	0,3	-2	-0,6
Total Score	0,7	-5	-1,3

Weight:

- 0,1 = Less Important
- 0,2 = Somewhat Important
- 0,3 = Important
- 0,4 = Very important

Rating:

- 1 = less threats
- 2 = Somewhat threats
- 3 = threats
- 4 = Very threats

The results internal and external analysis can be summarized as follows:

- Total Score *Strengths* = 3.1
- Total Score Weakness = -0.9
- Total Score Opportunity = 2.7
- Total Score Treats = -1.3

Find out coordinate matrix:

- Coordinate Analysis Internal

$$(\text{Total Score Strengths} - \text{Total Score Weakness})/2 = (3.1 - 0.9)/2 = 1.1$$

- Coordinate Analysis External

$$(\text{Total Score Opportunity} - \text{Total Score Treats})/2 = (2.7 - 1.3)/2 = 0.7$$

Coordinate position result for Matrix SWOT: (1.1 ; 0.7)

Diagram Matrix SWOT result for the process can be seen on Figure 6.

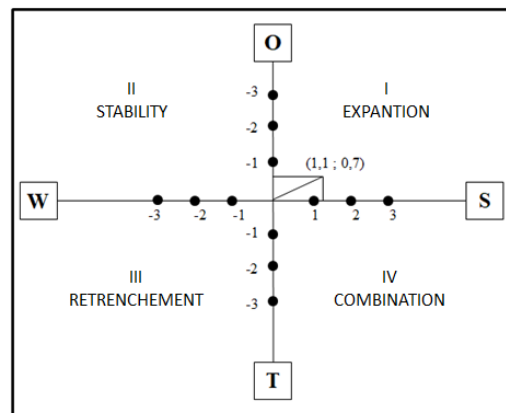


Figure 6 Result of diagram matrix SWOT.

The result of position is in quadrant I. it can be concluded that the automation process by using robots for Out Door Forming process for the refrigerator door at the Manufacturing Company has a positive impact and feasible to implemented.

5 Conclusion

Automation by using Robot for the Out Door Forming process have positive impact to increasing productivity, in this research showed a 30% decrease in takt time which illustrates the increase in production capacity to 30% from manual system. Automation using Robot have advantages movement of process more flexible and stable, impact can eliminated loss motion.

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