

## Identification of Defects in Electronic Component Products: Case Study at PT Omron Manufacturing of Indonesia

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### Abstract

The identification of product defects at Omron Manufacturing of Indonesia is motivated by the large number of defect discoveries in the January-October 2023 period, these defects cause considerable losses, namely the number of product parts disposed of in the amount of 3591. Based on these problems, the purpose of this research is to identify the causes of defects and formulate alternative solutions for continuous improvement. Identification of defects using the Pareto diagram method, fishbone analysis, and failure mode and effect analysis (FMEA), after getting the cause with the highest risk of priority number (RPN) value, the next step is to find alternative solutions using the 5W + 1H kaizen approach. The output generated from this research is daily checklist maintenance for operators and weekly checklist maintenance for the productive maintenance department.

**Keywords:** Pareto chart, Fishbone diagram, FMEA, Identification of Defect Product

### INTRODUCTION

Quality has a very critical role for consumers in their purchasing decisions (Oktavenia et al., 2019). Many manufacturing businesses and some service businesses are currently using lean management principles, principles as a means to improve business processes, increase productivity and competitiveness including quality, and deliver greater value to end-user customers (Wicaksono and Rozak, 2020). If the company produces good product quality, consumers tend to make repeat purchases, whereas if the quality is not as desired, consumers will buy other similar products (Adeosandi et al., 2023). According to the results of Afnina and Hastuti's research, there is a positive and strong relationship between customer satisfaction and product quality (Afnina and Hastuti, 2018). Product quality, service quality, and brand image have a significant and positive effect on interest in repurchasing, this means that the higher the quality of service, the more interest in repurchasing will increase (Aryadhe and Rastini, 2021). Therefore, a product that has good quality will invite consumers to repurchase the product.

PT Omron Manufacturing of Indonesia is a manufacturing company that produces electronic components in relays, timers, sensors, power supplies, and switches (Laetitia 2022). Quality control at PT Omron Manufacturing of Indonesia includes input, process, and output control, the department responsible for input quality is the quality control (QC) department, quality control in the production process is carried out by the leader and leading line, quality control at the output is carried out by the quality assurance (QA) department. In the production process, PT Omron Manufacturing of Indonesia is inseparable from the discovery of defects or not good in the products produced. One of the Siregar defect problems occurs in line 1 H3CR timer products. The identification of defects in the IAB line one H3CR department is motivated by the large number of material/part products that are disposed of, the disposed parts include base assy, PWB, and lead wire.

Defect identification uses several methods, namely fishbone analysis, Pareto diagrams, and failure mode and effect analysis (FMEA). while the formulation of alternative solutions uses the 5W + 1H kaizen approach. Pareto diagrams help management quickly identify the most critical things that require special and immediate attention (Siregar and Nasution, 2018). In the Pareto diagram, the problem categories are organized by size, from the largest to the smallest on the right (Oktavia and Herwanto, 2021). Ishikawa diagram, commonly called the cause-and-effect diagram, is a matrix that

shows the causes or factors that cause a problem and how they can be categorized (Gata and Gilang, 2017). The Ishikawa diagram has the same shape as a fishbone where the "fish head" is the problem to be solved (Widnyana et al, 2022). FMEA divides the target industrial product into parts to list the physical abnormalities of the parts (Takahashi, Kosaka et al, 2016). The most potential cause in the fishbone analysis will be calculated as the value of the risk of priority number (ROP) in the FMEA method. The 5W+1H kaizen approach is used to make predictions from the elements of what, who, where, when, why, and how (Nurdin and Maulidevi, 2018).

This study aims to find the root cause of the problem of the number of components in the H3CR type timer product that are wasted and formulate alternative solutions so that the problem can be reduced using the Pareto diagram method, fishbone analysis, FMEA, and the 5W1H approach. This study also aims to provide advice and information to companies to improve quality control and preventive maintenance on several critical machines. good quality control will minimize the appearance of defects and eliminate unnecessary failure costs (Luayyi and Ardiyanti, 2023).

## **METHODS**

This research was conducted in the Industrial Automation Business (IAB) production department line one H3CR on timer production. This research has several stages, the first stage is data collection, the data used is primary data obtained from interviews with relevant sections, and secondary data in the form of a literature review. The second stage is data processing using several methods. The following are the methods used in this study, namely.

### **1. Pareto diagram**

A Pareto diagram is a graph or diagram that interprets the hierarchy of problems that arise so that it functions to determine the main priorities in problem-solving (Rohani and Suhartini, 2021). There are stages in making a Pareto diagram (Sari and Supardi, 2022), as follows:

- a. Determine the part (item/topic) in data collection
- b. Determine the period, then collect the data
- c. Calculate the amount according to the part (item) of the data, i.e. the number, the accumulated amount, and the percentage
- d. Draw a diagram from the largest to the smallest amount of data
- e. Draw a curve graph showing the accumulated data
- f. Draw a vertical line through the point of 100% cumulative sum
- g. Write the cumulative percentage on the vertical line

### **2. Fishbone diagram**

A fishbone diagram commonly referred to as a cause and effect diagram is a diagram that looks like a fishbone which has many branches that show the cause and effect of a problem (Dwiyanti et al., 2023). This diagram helps to think and identify risks through the cause of the problem, the fishbone diagram helps to know the cause of the problem from the aspects of material, man, machine, and method (Hamid et al., 2017). Fishbone diagrams are also used to find out the root causes of existing problems so that they can carry out risk assessments (Purwanggono and Margarete, 2017).

### **3. Failure Mode and Effect Analysis (FMEA)**

The use of the failure mode and effect analysis (FMEA) method was first pioneered in 1960 by the aerospace industry, then in 1974, the Navy developed the so-called Mil-Std-1629 FMEA procedure which became the FMEA format that is often used today, FMEA became famous after that and was used by the automotive industry to solve problems regarding quality (Immawa et al., 2018). FMEA is a structured procedure for identifying and preventing as many failures as possible (Failure mode), FMEA is used to identify the source and root cause of quality problems (Helia and Wijaya, 2017). According to Siregar, 2018 there are stages in the preparation of FMEA as follows:

- Identify functions in the production process
- Identify potential failure modes of the production process
- Identify potential effects of production failure
- Identify the causes of the failure of the production process
- Identify production process detection modes

- Determine rating on severity, occurrence, detection, and RPN production process

Determining the severity, occurrence, and detection values is a step to evaluating failure (Saputra, 2018). The following is the definition of the three factors

- Severity - The consequence of the failure must occur
- Occurrence - The frequency or probability of the failure occurring
- Detection - The frequency with which the failure is detected before the impact of the effect is realized.

In determining the severity, occurrence, and detection values, there is a table containing the criteria and their values. The following is a table of severity, occurrence, and detection values (Saputra, 2018)

Table 1. Severity Score

<b>Rating</b>	<b>Effect</b>	<b>Kriteria Severity</b>
10	Fails to meet safety and regulatory requirements	Failure may jeopardize the operator, system, or component without warning
9		Failure may jeopardize the operator, system, or component with a warning
8	Major disruption	System inoperable: disruption may result in the system being inoperable from the outset.
7		System inoperable: fault may result in normal system trip
6	Moderate fault	The system can operate but not normally: there is a fault in the system components which can cause an impact on the system.
5		The system can operate but not normally: there is a disturbance in the system components and no impact on the system.
4	Low disruption	The system can operate normally: but there is a disturbance in the system components which can cause the system to experience a decrease in performance.
3		The system can operate normally: there is a disturbance in the system components but it does not cause the system to experience a decrease in performance.
2	Minor disruption (small)	The system can operate normally: the effect of the disruption is small and disrupts the system operation process.
1	No effect	The system operates normally. The effect of the disturbance does not interfere with the system operation process/no obvious effect.

Table 2 Occurrence Score

<b>Failure Probability</b>	<b>Occurrence</b>	<b>Rank</b>
<b>Very high</b>	100 Per 1000 (1 in 10)	10
	50 Per 1000 (1 in 20)	9
<b>High</b>	20 Per 1000 (1 in 50)	8
	10 Per 1000 (1 in 100)	7
<b>Medium</b>	2 Per 1000 (1 in 50)	6
	0.5 Per 1000 (1 in 2000)	5
	0.1 Per 1000 (1 in 10000)	4
<b>Low</b>	0.01 Per 1000 (1 in 100.000)	3
	0.001 Per 1000 (1 in 1000.000)	2
<b>Very Low</b>	Failures are eliminated through preventive controls (Preventers)	1

Table 3 Detection Score

<b>High/low probability of detection</b>	<b>Rank</b>	<b>Note</b>
<b>Almost impossible</b>	10	No current process control tools: unable to detect failure
<b>Very small/thin</b>	9	Failure detection (cause) is not easily detected by control tools or operators.
<b>Minor</b>	8	Failure detection because the system cannot be operated from the start.
<b>Very Low</b>	7	Failure detection because the system trips
<b>Low</b>	6	Failure detection by the operator: due to a system component that has changed settings
<b>Medium</b>	5	Failure detection by the operator: due to a system component experiencing interference
<b>Moderately high</b>	4	Failure detection by operator: failure detection due to unplanned inspection of the system
<b>High</b>	3	Failure detection by the operator: failure detection due to a routine inspection of the system
<b>Very High</b>	2	Detection due to control devices on the system: early warning alarms
<b>Almost certain</b>	1	Failure detection due to a control device on the system, automatically detects the failure and prevents further processing.

#### 4. 5W1H

The 5W+1H technique is a basic concept that has a function as information gathering, in this concept, it is very detailed that the question sentence used is 5W+1H which means what (what), when (when), who (who), where (where), why (why), and how (how) (Danastiningrum and Akbar, 2019). In a study, it was stated that 5W1H as one of the theoretical foundations in modeling successful learning empowered teachers to succeed in teaching (Faizah et al, 2022). Overcoming the problem of a 5W1H extraction system that can automatically present the main information in each news is proposed (Nurdin and Maulidevi 2017).

## RESULTS AND DISCUSSION

### Defect Identification and Defect Cause Analysis

Problem identification is carried out after the author has finished observing or researching data on the type and number of defects in the IAB line 1 H3CR department. Problem identification uses three methods, namely Pareto diagrams, fishbone analysis, and FMEA, the following are the results of problem identification using these three methods.

#### 1. Pareto Diagram

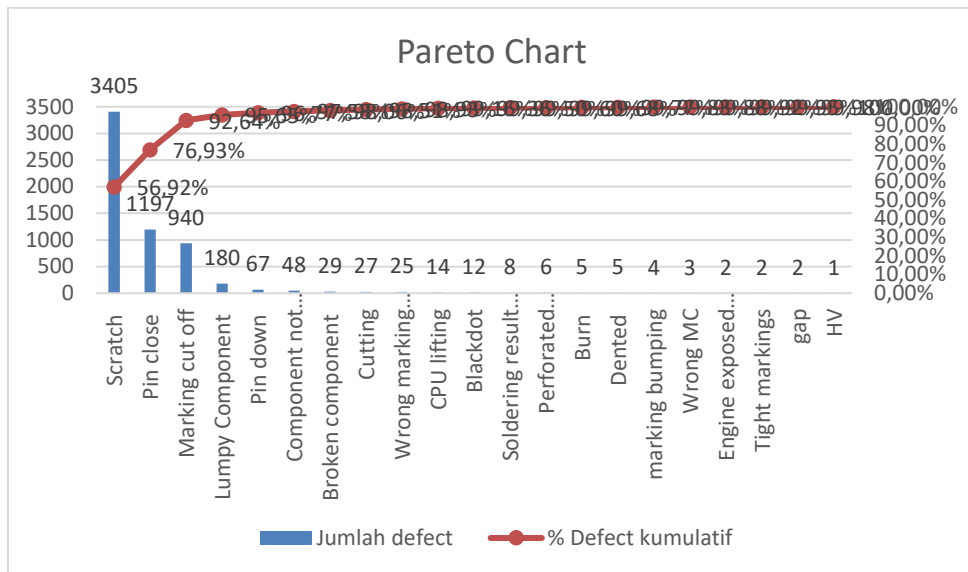
Pareto diagrams are used to sort defects with the most occurrences to the smallest to find which problems are the most important problem and must be resolved immediately, and which problems can be postponed. The following is a recapitulation of data on the types and number of defects of H3CR type timer products taken in the period January 02, 2023 - October 18, 2023.

Table 4 Timer Product Defect Type and Number Data

Data on Type and Number of Defects of H3CR Type Timer Products Jan-Oct 2023				
Nu	Defect type	Defect count	% Defect	% Cumulative defect
1	Scratch	3405	56,92%	56,92%
2	Pins close	1197	20,01%	76,93%
3	Marking cut off	940	15,71%	92,64%
4	Lumpy Component	180	3,01%	95,65%
5	Pin down	67	1,12%	96,77%
6	Component not good	48	0,80%	97,58%
7	Broken component	29	0,48%	98,06%
8	Cutting	27	0,45%	98,51%
9	Wrong marking position	25	0,42%	98,93%
10	CPU lifting	14	0,23%	99,16%
11	Blackdot	12	0,20%	99,36%
12	Soldering result not good	8	0,13%	99,50%
13	Perforated components	6	0,10%	99,60%
14	Burn	5	0,08%	99,68%
15	Dented	5	0,08%	99,77%
16	marking bumping	4	0,07%	99,83%
17	Wrong MC	3	0,05%	99,88%
18	Engine exposed components	2	0,03%	99,92%
19	Tight markings	2	0,03%	99,95%
20	Gap	2	0,03%	99,98%
21	HV	1	0,02%	100,00%

Based on defect data obtained from the quality control (QC) and production departments. The defect problems that appear most often include scratch defects, pin closing defects, and cut

marking defects. After getting a recapitulation of the occurrence of the most to the smallest defects, the next is the creation of a Pareto diagram. The Pareto diagram can be seen in Graph 1.



Graph 1 Grouping Defects Using Pareto Diagram

The 80:20 Pareto principle is that 80% of nonconformities that occur are caused by 20% of the causes (Tajuddin and Junaedi, 2021). In accordance with the Pareto principle, improvements can be made by focusing on 2 types of defects, namely scratch defects. From scratch defects, closing pins, and cut markings, the cause that will be identified is the closing pin defect because this defect causes product components to be unable to be repaired and directly disposed of, three components are disposed of including: Base Assy, PWB, and Lead Wire. So the total components that were disposed of due to the "Pin Closing" defect from January-October 2023 were 3591 units. This makes the "Pin Closing" defect an important problem.

## 2. Fishbone analysis

Fishbone analysis is used to analyze the causes of pin closing defects, using 4 indicators, namely man, machine, material, and method. The following is an identification of the causes of the closing pin defect using fishbone analysis which can be seen in Figure 1.

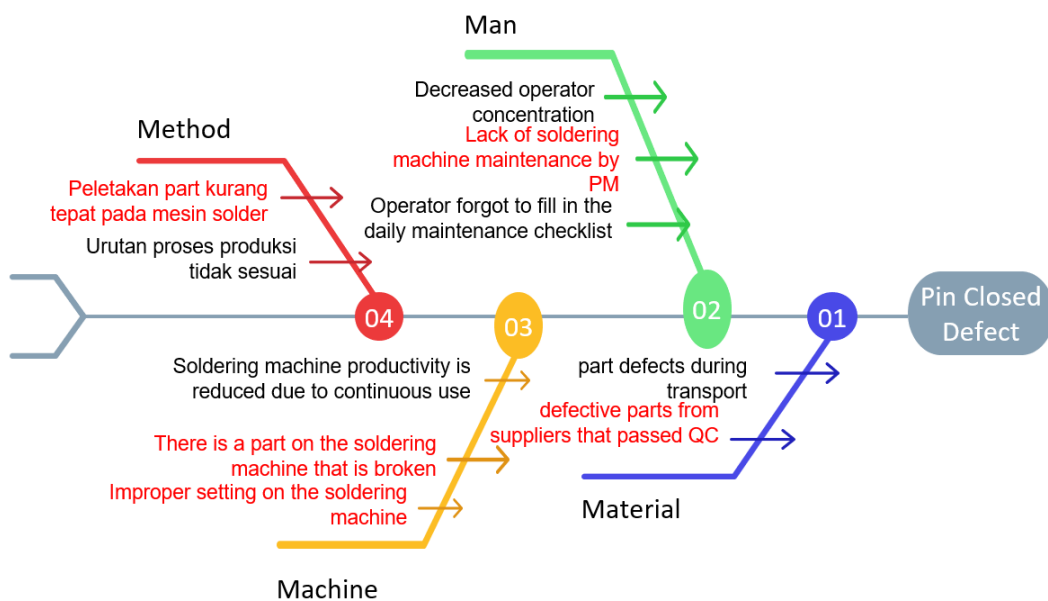


Figure 1 Identify the Cause of Defects Using Fishbone

Each indicator has a cause that is described through brainstorming sessions with related parties (Aristriyana and Fauzi, 2022). Based on the fishbone analysis above, the red-colored sentence is the most potential cause of the problem from each indicator. These causes will later be re-analyzed using the failure mode and effect analysis (FMEA) method.

### 3. Failure mode and effect analysis (FMEA)

FMEA is used to re-analyze the most potential causes of problems that have been identified in fishbone analysis. FMEA aims to find the highest risk of priority number (RPN) value which will then be prioritized in taking and determining actions and maintenance recommendations based on the FMEA method. The Risk Of Priority Number is a relative risk measurement, which results from multiplying severity, occurrence, and detection (Sabri and Putra, 2018). The following are the results of data processing using FMEA which can be seen in the following figure.

Component and function	Type of Failure	Potencial cause failure	Effect of failure	current control	Severity	Occurance	Detection	Risk Of
					(1-10)	(1-10)	(1-10)	Priority
H3CR line 1 soldering machine: serves to solder the base assy, PWB, and lead wire assemblies.	Pin Closes more than 3 on base assy, PWB, and lead wire assemblies	Improper soldering machine settings	The soldering results of the soldering machine are not in accordance with the specifications	Perform trial & error until you get the appropriate settings	6	10	5	300
		There is a part on the soldering machine that is	Decreased soldering machine performance	major maintenance once every 3 months & solder bit	6	8	3	144
		Improper part placement on the soldering machine	The soldering process could not run and the soldering results lacked precision	Work guidance sheet (WGS) & One point lesson	7	2	2	28
		Lack of soldering machine maintenance by PM	Problems with parts in the soldering machine are unknown	Major maintenance once every 3 months	7	5	7	245
		Product defects from suppliers that pass QC	NG items will be mixed with good items, and enter the production process.	Quality check by Quality control (QC) Departement	2	4	3	24

Figure 2 Failure Evaluation Using FMEA Method

Based on the analysis using FMEA, the highest RPN value is obtained, namely the improper setting of the soldering machine, and the lack of maintenance of the soldering machine by the PM department. Risks with the highest RPN values are projected as important risks and must get high-priority handling compared to risks that have low RPN values (Subriadi and Najwa, 2018). Risks with the highest RPN value will be analyzed using 5W + 1H to find alternative solutions.

### 4. 5W+1H Analysis

The 5W + 1H approach is a method that involves the ability to use question sentences so as to increase the accuracy of the results (Misrah et al., 2014), this is used to find alternative solutions to the causes of problems with the highest risk of priority (RPN) value. Kaizen 5W+1H consists of what, why, where, when, who and how. The following are the results of data processing using the 5W + 1H approach listed in Figures 3 and 4.

Proposed improvements with the 5W+1H method							
No	Factor	What	Why	Where	When	Who	How
1	Improper setting on the soldering	1. Perform trial & error to find the right setting on the soldering 2. Add the appropriate settings to the maintenance checklist.	1. To find the right parameters so that the soldering machine produces products that meet specifications 2. So that the settings on the soldering machine are in accordance with the predetermined parameters	Soldering machine on line 1 H3CR	During weekly maintenance	Pemimpin & lini terdepan H3CR beserta staf Productive Maintenance (PM)	In weekly maintenance. the leader, leading line 1 H3CR, and PM, conduct a thorough check by checking the parts on the soldering machine, the check includes checking parameters, functions, and appearance. Then check the workings of the soldering machine to find out that the soldering machine produces good products.

Figure 3 5W+1H Improper Settings on The Soldering Machine

Proposed improvements with the 5W+1H method							
No	Factor	What	Why	Where	When	Who	How
2	Lack of soldering machine maintenance by PM	1. Make improvements and add checking indicators to the daily checklist maintenance for line 1 H3CR operators.	1. To control the parameters and performance of the soldering machine every day before the production process.	Lini 1 H3CR & departemen pemeliharaan produktif (PM)	1. Daily checklist maintenance = carried out every day both before production starts and during breaks	1. Pemeliharaan daftar periksa harian: <b>Periksa</b> = Operator line 1 H3CR and <b>Approved</b> = leader line 1 H3CR	1. Daily checklist maintenance: There are check points and specifications on the checklist, the operator checks each point, if appropriate then give a sign (✓) and some are filled in with numbers. Some checks are carried out twice as stated in the checklist.
		2. Membuat pemeliharaan mingguan untuk departemen pemeliharaan produktif (PM)	2. Carry out repairs and checks on the soldering machine parts as a whole in terms of parameters, functions, and appearance. and identify problems with the soldering machine if there are abnormalities.		2. weekly maintenance = Performed once every one week	2. Pemeliharaan mingguan : <b>Issued</b> = departemen PM, <b>Check</b> = staf PM, dan <b>approve</b> = Supervisor PM	2. Weekly maintenance checklist: There are check points and specifications on the checklist, the operator checks each point, if it is appropriate then put a mark (✓) in the OK column and if it is not appropriate put a mark (✓) in the NG column. Checks include machine parts and machine operation

Figure 4 5W+1H Lack Of Soldering Machine Maintenance By The Productive Maintenance (PM) Department

Based on the 5W+1H approach that has been carried out, alternative solutions to minimize the appearance of defects are determining the appropriate settings on the soldering machine by trial and error, and making weekly and daily maintenance checklists to control the performance of the soldering machine.

### Alternative Solution Results

Based on analysis using the 5W + 1H approach, an alternative solution is obtained to minimize abnormalities in the soldering machine, namely by making daily checklist maintenance for operators and weekly check maintenance for the productive maintenance (PM) department. According to Apriliani et al., 2022 Checklist is one of the observation tools, that is used to obtain data, in the form of a list containing factors and including the subject to be observed by the observer, where the observer in carrying out observations in the field just gives a check mark (checked) on the list of factors according to the behavior of the object that appears, on the observation sheet, thus allowing the observer to carry out his duties objectively and efficiently because the observer only makes observations based on the things contained in the list. The following is an explanation of daily checklist maintenance and weekly checklist maintenance. according to seiichi nakajima In general, maintenance can be defined as preventive actions that is carried out to maintain the performance condition of a machine/equipment remains optimal/prime but with the lowest possible maintenance costs (Kurnia et al., 2023)

#### 1. Daily Checklist Maintenance

Daily checklist maintenance is a daily checklist intended for H3CR line 1 operators. This checklist contains a list of soldering machine components and their specifications that must be checked every day before the start of the production process. This checklist is mandatory to ensure that the soldering machine is in good condition and produces good products. This checklist is filled in by the H3CR line operator, checked and approved by the production leader. The following is daily maintenance which can be seen in Figure 5.

#### 2. Weekly Checklist Maintenance

Weekly checklist maintenance is a weekly checklist intended for the productive maintenance (PM) department. This checklist contains a list of soldering machine components and their specifications and checks on machine operation. This checklist is filled in by PM staff. The following is weekly maintenance which can be seen in Figure 6.

## WEEKLY MAINTENANCE CHECKLIST & RECORD

Date : \_\_\_\_\_  
 Departement : \_\_\_\_\_  
 Line : \_\_\_\_\_

Issued	Checked	Approved
PM		

Machine :	Type/Model :
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PART MACHINE						
No	Item check	Description	Result (v)		Description & Action	Done by
			OK	NG		
1	Jig	Pecah, Kotor, longgar.				
2	Sucker Tube	Tersumbat, Kotor, Plak				
3	Solder Bit	Pecah, Plak, Kotor, posisi kendur.				
4	Needle	Kotor, Plak, Tersumbat, bengkok, posisi kendur.				
5	Red Switch	No detect				
6	Heater	No stable				
7	Connector	Putus, Kendur				
8	Servo Motor	Putaran terhambat, Suara abnormal				
9	Toggle	Kotor, K eset, Dpl				
10	Feeding timah	Posisi bergeser, tidak lancar				

MACHINE OPERATION					
No	Maintenance Point	Result (v)		Description & Action	Done by
		OK	NG		
1	Mesin beroperasi dengan normal				
2	Proses soldering sesuai (max. : 3 Pin menutup)				
Catatan:	1. Beri tanda (v) pada kolom OK apabila kondisi item check dan maintenance point dalam kondisi baik.				
	2. Beri tanda (v) pada kolom NG apabila kondisi item check dan maintenance point dalam kondisi not good.				
	3. Bila kondisi NG, tulis deskripsi NG dan penanganan yang perlu dilakukan pada kolom "Description & Action"				
	4. Urutan maintenance adalah Part Machine baru kemudian Machine Operation				
Keterangan:					

Figure 5 Weekly Checklist Maintenance & Report

# DAILY MAINTENANCE CHECKLIST & RECORD

Month/Year : \_\_\_\_\_  
 Department : \_\_\_\_\_  
 Line : \_\_\_\_\_  
 Process : \_\_\_\_\_

Checked	Approved
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No	Item check	Specification	Month																															
			Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	*Temperature Solder*	350°C ± 10°C	1																															
			2																															
2	Drain voltage	<2mV	1																															
			After change																															
3	Resistance	<2Ω	1																															
			After change																															
4	Air pressure	400-600 kPa	1																															
5	Air blow	Before/ after	1																															
			2																															
6	Safety sensor	Before/ after	1																															
			2																															
7	Sucker	Before/ after	1																															
			2																															
8	*Feeding speed*	Max 23mm	1																															
			2																															
9	*Trough dan Tip (Liping) solder*	- Take foreign material - Take solder - Take solder	1																															
			2																															
10	*Life time solder, record	1. Life time solder (MAX: 40,000) 2. Lifetime solder (MAX: 40,000)	1																															
			2																															

Figure 6 Daily Checklist Maintenance & Report

## CONCLUSION

Based on the objectives and implementation of this industrial internship activity, the information that can be concluded is: The reason for the large number of timer product components in the form of PWBs, lead wires, and base assemblies that are disposed of, is caused by the closing pin defect, the closing pin defect is caused by the abnormality of the soldering process on the soldering machine in more detail due to the lack of maintenance on the soldering machine by the PM department and improper settings on the soldering machine, Alternative solutions to prevent the appearance of closing pin defects are to carry out daily and weekly maintenance, as well as the addition of quality control tools in the form of weekly checklist maintenance for PM and daily checklist maintenance for production operators. Suggestions from researchers are the implementation of routine preventive maintenance on a daily and weekly basis on critical tools or machines, In addition, it is also necessary to add quality control tools in the form of checklists to control maintenance activities and record every checking activity.

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