Defects Evaluation in Sanitary Product Using Seven Tools Method

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Abstract

PT. SPM is a company engaged in the manufacture and sale of sanitary products. The company produces more than 1000 pcs of sanitary products daily, but many are also defective. Therefore, research will be conducted to determine the type and number of defective products, the factors that cause defective products, and the efforts made to reduce defective products. The quality control division researched defective products from June 2021 to May 2022. Data collection techniques used observation, interviews, and documentation studies. The analysis technique uses the Seven Tools method and 5W+1H analysis. The product has several defects based on the research results, such as a cracked body, small holes, dusty body, kama dust, thin glaze, lacking body, wave body, and speckled glaze. Defective products are caused by several things, namely low operator concentration, lack of production operator skills, inaccuracy of production operators, lack of human resources, machines not working optimally, decreasing gas in the combustion process, and equipment not according to standards. Efforts that can be made to minimize the occurrence of defective products are increasing the number of training in each division, increasing the number of human resources, regularly maintaining and repairing machines, and carrying out work processes in accordance with SOP.

Keywords: Product Defects, Quality Control, Production Process, Seven Tools, 5W+1H

1. Introduction

Line with the increasingly rapid growth in the economic sector, which is marked by rapid development in all fields, requires entrepreneurs in Indonesia always to be ready to anticipate any changes that occur in economic activity. This causes very tight competition between industries to market their respective products. One way to win the competition is to produce high-quality products (Imron, 2019). Quality is often interpreted as a measure of how far a product meets the requirements or quality specifications set (Retnowati et al., 2022; Santoso & Fudhla, 2018). To be able to get and maintain product quality well, quality control is necessary. By controlling quality, it is also expected to reduce the number of defective products (Supriyadi, 2018). Moreover, it can reduce waste in terms of materials and other production costs(Chrisna, 2018).

Problems related to product quality are still faced by several manufacturing companies today. One of them is PT. SPM is engaged in the manufacture and sale of sanitary equipment. The company can produce more than 1000 pcs of products daily, but the number of defective products that appear is still high. The high number of defects requires companies to improve and control the quality of their products. The seven tools method is a primary method for testing quality that can help companies solve problems and improve processes because companies need the seven tools to develop to the top (Somadi et al., 2020). The seven-tools method includes seven control tools, including check sheets, stratification, histograms, Pareto diagrams, scatter charts, control charts, and cause-and-effect diagrams. At the same time, the 5W + 1H analysis is used to design to overcome the company's existing problems. The 5W+1H analysis includes, What means what problems will be repaired, Why means why repairs are needed, Where which means where to make repairs When which means when repairs will be made, Who which means who is responsible for repairs, and How which means the strategy to overcome (Somadi & Fakhrudin Hidayat, 2019). Based on the problems above, the seven tools method and the 5W + 1 H concept are used in this study, which is expected to help PT. SPM to overcome the problem of defective products, and the company can also find out the "root cause" of the problem so that the recommended solution can be right on target.

2. Literature Review

According to Montgomery (2019), quality control is an engineering and management activity. We measure product quality characteristics, compare them with specifications or requirements, and take appropriate remediation actions if there is a difference between the actual appearance and the standard one. Quality control aims to maintain product quality standards promised by the company to consumers. Control measures can help maintain the performance of the production process within the allowable tolerance limits. The purpose of holding quality control, according to Irwan & Haryono (2015), is so that the product specifications set in the quality policy can be reflected in the production results. According to Irwan & Haryono (2015), organizations use several quality improvement techniques or tools: check sheets, histograms, cause-effect diagrams, scattered diagrams, flow charts, Pareto diagrams, and control charts. Each technique has uses that can stand alone or help each other between one technique and.

3. Methods

This study uses a quantitative approach with an analytical technique using the seven tools method and 5W+1H analysis. Seven tools are essential quality testing tools that can help companies solve problems and improve processes because seven tools are indispensable for every organization to develop towards the peak of excellence(Wisnubroto et al., 2018). The research method was carried out on products declared defects by the quality control (QC) section from June 2021 to May 2022. Data collection technics using observations, interviews, and documentation studies. As for the steps of the seven tools, follow(Irwan & Haryono, 2015)

1. A check Sheet is a document containing a list of things needed for recording data so that data collection can be carried out efficiently, systematically, and regularly when that data appears at the scene of the incident.
2. Stratification is an attempt to untangle or classify a problem into smaller groups, groups, or single elements of the problem.
3. The histogram is a bar chart used to indicate the presence of data dispersion and frequency distribution. A frequency distribution shows how often each different value in a data set occurs.
4. Scatter diagrams express the correlation or relationship between one factor and the characteristics of another or cause and effect.
5. The control chart is a map to study how the process changes over time. Through this picture, it will be detectable whether the process is running stable or not. The characteristic of this graph is the presence of a pair of control limits (upper and lower limits) so that from the collected data, a tendency to the actual process conditions will be detected.
6. A Pareto diagram is a chart that contains a bar chart and a line chart. Bar charts show classifications and data values, while line charts represent cumulative totals of data.
7. A cause-and-effect diagram, commonly called a Fishbone Diagram, is a tool to identify various potential causes of a single effect or problem and analyze the problem through brainstorming sessions. The problem will be broken down into related categories, including people, materials, machines, procedures, policies, etc. Each category has causes that need to be outlined through brainstorming sessions.

The 5W +1H analysis is used to investigate the problems that occur and to solve problems that occur with the help of What, Where, Why, Who, When, and How analysis (Hardono et al., 2019). The steps for the 5W +1H analysis carried out in this study include the following:

1. What: What are the problems that need corrective action?
2. When: When can repairs be made?
3. Who: Who is the party that can take such remedial action?
4. Where: Where can corrective actions be taken?
5. How: How do I fix the problem?

4. Result and Discussion

4.1 Check Sheet

Product inspection at PT. SPM uses a *Check Sheet* observation sheet which aims to provide information in the form of product types with defects/thoughts, including 17 types of defects. The following is a picture of the check sheet recorded by the QC department.

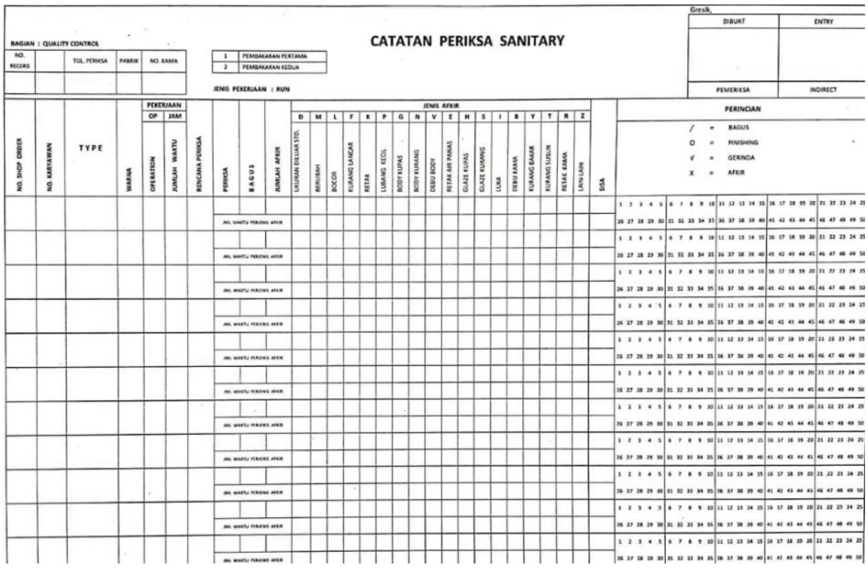

Figure 1. Check sheet

Each production line contains one type of product. After the combustion process is complete, a defect/ thought check is carried out according to the disability/thought column. The detailed column determines the product's overall state by marking the number according to the order. If the defective product is given a mark (X), a good product is given a mark (/), and the product that requires grinding is given a mark (V), and a mark (O) for finishing.

The number of defects/thoughts that have been grouped will then be processed into more concise data to determine the percentage of thoughts produced per week for one year. The following is processed data from defective products for one year, from June 2021 – May 2022.

Table 1. Processed data Check Sheet products type TJ6 &TD42L

Period (Week)	TJ6			TD42L		
	Number of Products	Number of Rejects	% reject	Number of Products	Number of Rejects	% reject
1	4842	532	11%	1494	468	31%
2	5443	693	13%	1486	399	27%
3	5476	637	12%	1516	369	24%
4	5043	465	9%	1269	342	27%
…						
…						
50	762	142	19%	388	120	31%
51	3825	768	20%	1488	418	28%
52	4637	855	18%	2074	570	27%
53	2057	363	18%	950	266	28%

4.2 Stratification

Through the *check sheet*, there are 17 types of defects which include: size outside the standard (D), changed (M), leaked (L), less smooth (F), cracked (K), tiny holes (P), peeled body (G), body less (N), body dust (V), hot water crack (S), peeled glaze (H), less glaze (S), wound (I), kama dust (B), less burning (Y), less stacking (T), kama crack (R), and others (Z). The data on the number of defects/thoughts that have been known will then be grouped based on 17 types of defects/thoughts contained in the *check sheet* and product types every month. The figure below is a stratification table image that has been grouped from June 2021 – May 2022.

Tahun	Bulan	Tipe Produk	Jml. Afkir	KODE KERUSAKAN																	
				D	M	L	F	K	P	G	N	V	E	H	S	I	B	Y	T	R	Z
2021	JUNI	TJ6	2587	1	103	62	72	1050	362	47	440	78	49	57	44	78	61	4	2	60	18
		TD42L	1725	2	69	41	48	737	242	31	293	52	33	38	R	52	35	0	1	40	12
		TD319L	2050	1	82	49	57	839	287	37	349	62	39	45	35	62	45	0	1	47	14
		TD310L	1463	0	59	35	41	605	205	26	249	44	28	32	25	44	27	0	0	34	10
		TD522L	1771	0	71	43	50	728	248	32	301	53	34	39	30	53	36	0	1	41	12
		TD516L	1023	1	41	25	29	426	143	18	174	31	19	23	17	31	14	1	0	24	7
		H68N	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JULI	TJ6	1420	0	57	34	40	588	199	26	241	43	27	31	24	43	26	0	0	33	10
		TD42L	1496	0	60	36	42	618	209	27	254	45	28	33	25	45	28	0	0	34	10
		TD319L	1759	0	70	42	49	723	246	32	299	53	33	39	30	53	36	0	1	40	12
		TD310L	994	0	40	24	28	417	139	18	169	30	19	22	17	30	13	0	0	23	7
		TD522L	1837	2	73	44	51	752	257	33	312	55	35	40	31	55	38	0	1	42	13
		TD516L	845	1	34	20	24	356	118	15	144	25	16	19	14	25	8	0	0	19	6
		H68N	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 2. Stratification of each type in June-July 2021

2022	APRIL	TJ6	3319	1	133	80	93	1350	465	60	564	100	63	73	56	100	83	0	0	76	23
		TD42L	2611	0	104	63	73	1067	366	47	444	78	50	57	44	78	61	0	0	60	18
		TD319L	1000	0	40	24	28	418	140	18	170	30	19	22	17	30	13	0	1	23	7
		TD310L	1148	0	46	28	32	477	161	21	195	34	22	25	20	34	17	0	1	26	8
		TD522L	1991	0	80	48	56	817	279	36	338	60	38	44	34	60	43	0	0	46	14
		TD516L	789	0	32	19	22	333	110	14	134	24	15	17	13	24	7	0	1	18	6
		H68N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MEI	TJ6	2128	0	85	51	60	872	298	38	362	64	40	47	36	64	47	0	0	49	15
		TD42L	1374	0	55	33	38	569	192	25	234	41	26	30	23	41	24	0	0	32	10
		TD319L	457	0	18	11	13	197	64	8	78	14	9	10	8	14	0	0	0	11	3
		TD310L	970	0	39	23	27	407	136	17	165	29	18	21	16	29	12	0	0	22	7
		TD522L	1991	0	80	48	56	816	279	36	338	60	38	44	34	60	43	0	1	46	14
		TD516L	789	0	32	19	22	332	110	14	134	24	15	17	13	24	7	2	0	18	6
		H68N	355	0	14	9	10	151	50	6	60	11	7	8	6	11	0	2	0	8	2

Figure 3. Stratification of each type in April-May 2022

4.3 Histogram

The histogram serves to indicate the number of defects. The x-axis indicates the product type, and the y-axis represents the frequency of defects of each type. Data stratification/grouping of data based on the type of thought will then be presented as a histogram graph. Each stem has a different color according to the type of defect/ thought.

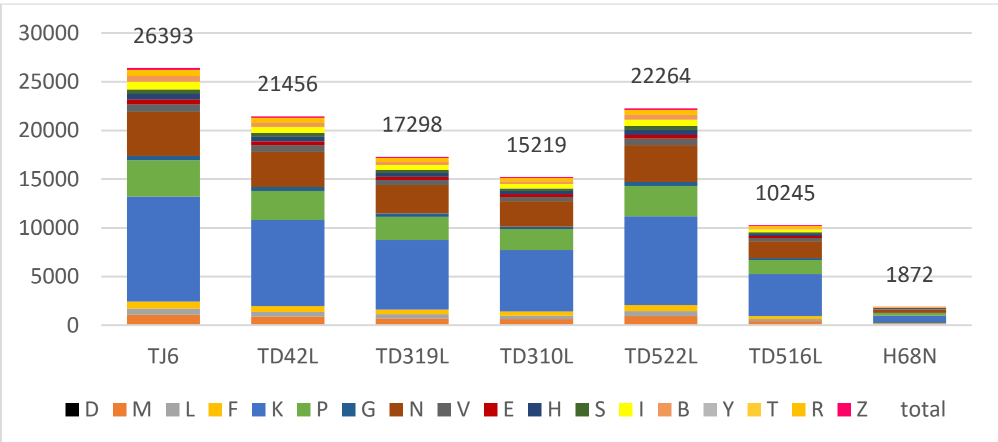

Figure 4. Histogram chart of defective products

Each chart bar represents one type of product with the total number of items listed above the bar. There are three dominant colors in the histogram chart above, including light blue, which represents the defects code K for cracks; brown, which represents the defects code N for the less body; and green which represents the defects code P for small holes.

4.4 Scatter Chart

Scatter Diagrams help look at a pattern of relationships between two variables. The data for this study was the number of nitrifications on the entire product for one year, which was processed into 53 weeks. Below is *the Scatterplot* data of the period (week) and the total number of defects each week; this is used to determine the change in the number of defects in 53 weeks.

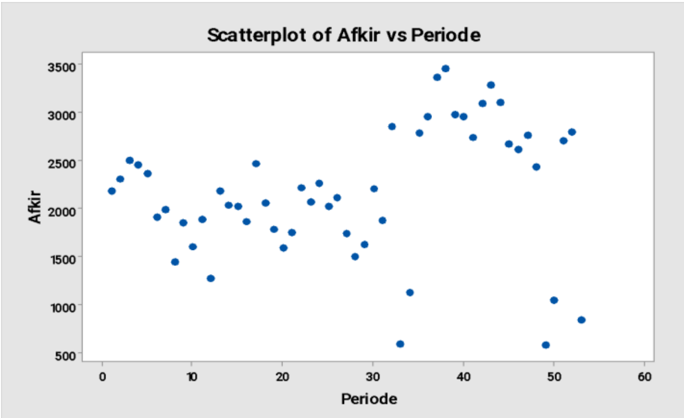

Figure 5. Scatter diagram of the correlation between the period and number of products

Based on the *scatter* diagram above, it can be concluded that the number of defects in all types has increased over 53 weeks. This can be influenced by several factors ranging from raw materials to the production process. Therefore, repairs are needed to minimize the number of defects/thoughts produced during the production process.

4.3 Control Chart

A control chart is a tool for evaluating a process, whether it is in a steady state or not. To determine whether the process is controlled or not, this study uses a P control map to determine whether the product experiencing disability is still within the required limits. In addition, because the company performs 100% inspection, the control chart measurement must use a control map of the proportion of errors. The control map p can help control the product quality and provide the company with the time and location of corrective actions. The advantage of the p control map is its accuracy in deciding whether the sample is within or beyond control limits. The determination of the middle line, the lower controlling limit, and the upper controlling limit are:

The following formula calculates the middle line:

$$\underline{p} = \frac{\Sigma X}{\Sigma n} \tag{1}$$

Next will be determined the upper control limit and the lower control limit using the following formula:

$$UCL = \underline{p} + 3\sqrt{\frac{\underline{p}\left(1-\underline{p}\right)}{ni}} \tag{2}$$

$$LCL = \underline{p} - 3\sqrt{\frac{\underline{p}\left(1-\underline{p}\right)}{ni}} \tag{3}$$

Information:

$\underline{p}$: The center line of the proportion control map error

ΣX : Total defects
Σ*n* : Total production
Pi : Error proportion of each sample/sub-group on each observation
ni : The number of samples taken on each observation varies

The samples taken in the study were in the form of the amount of production and the number of goods from June 2021 – May 2022. Figure 6 is a *control chart* of each type for one year.

Figure 6. Control Chart (p-chart) of each sanitary product

The control chart above (Fig. 6) is a revision of the previous *control chart*, which had sample points outside the upper limit (UCL) and lower limit (LCL) due to special conditions that include humans, machines, methods, matter, and the environment. The revised diagram shows that *the control map p* for each type has been within the control limits because none of the sample points pass through the UCL and LCL. A recap of the results of the control map p as follows:

Table 5. Control map recapitulation

Product Type	$\underline{p}$
TJ6	0,12056
TD42L	0,3479
TD319L	0,3263
TD310L	0,1878
TD522L	0,1801
TD516L	0,2483
H68N	0,3388

The higher $\underline{p}$ the value, the higher the proportion of defects/thoughts produced. Based on the calculation of *the control charts* above, the type of product with the highest value is the TD42L product, then the type of product with a high proportion value will be evaluated to find out the root of the problem of the defect/thought $\underline{p}$.

4.4 Diagram Pareto

The Pareto diagram aims to clarify the most significant of several existing factors. The number of known types of defects/defects is then presented in the Pareto diagram to determine which defects/thoughts need to be repaired. In the Pareto diagram below, the types of defects that need to be repaired with a cumulative percentage of 82% are K (crack), N (body less), P (small hole), M (change), I (wound), and V (body dust).

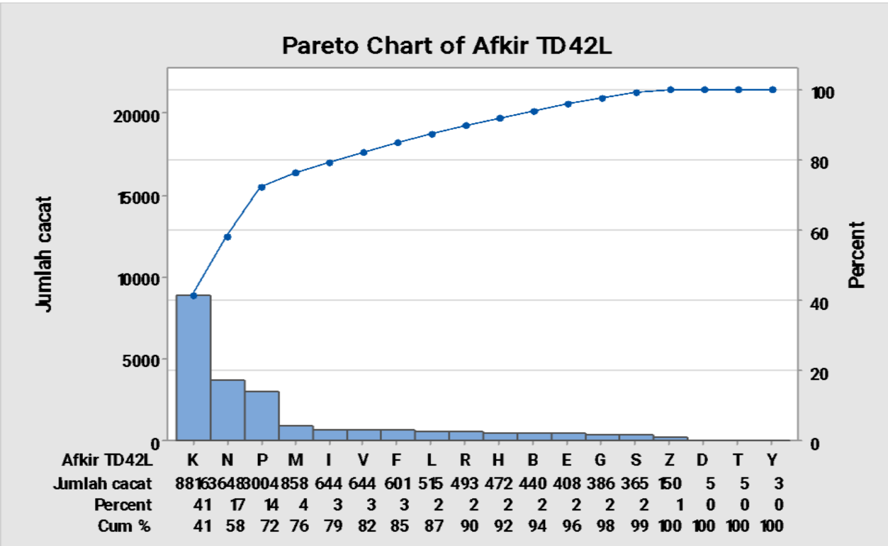

Figure 7. Pareto diagram

4.3 Fishbone Diagram

This fishbone diagram aims to find the root cause of the problem that occurs in PT. SPM is the leading cause and the root cause of the primary cause. Thus fishbone diagram analysis can be used to analyze the causes of body problems in Production systems.

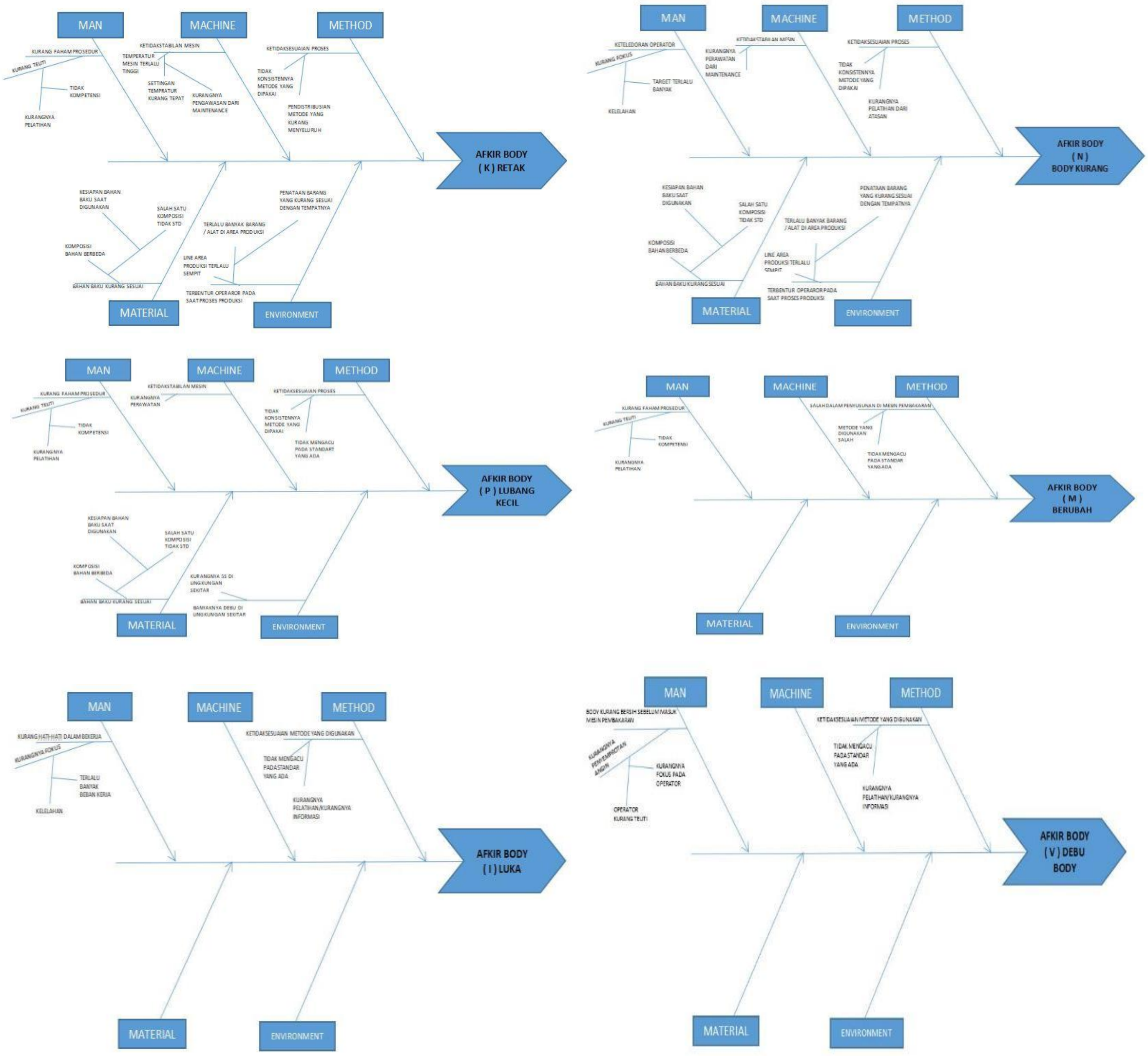

Figure 8. Fishbone diagram of each defect

Based on the *fishbone* image above (Figure 8), it is found that the cause of the problem from the branch to the root will be improved to the root of the problem so that the problem does not continue to occur. Like some *fishbones*, there are the same problems between defects/thoughts so that the company can overcome the problems quickly and efficiently.

Table 6. Causal Analysis

Factor	Cause	Effect
Man	Lack of understanding of the correct work procedure.	There are errors in the production process that result in defects in the body.
	Lack of thoroughness in the process of work.	There are errors before, and after entering the combustion process, so dust defects on the body and defective products can pass the inspection.
	Wrong in the preparation of the combustion engine body	Body may deform
	Lack of caution in work	The occurrence of collisions between bodies due to careful body preparation causes injuries to the body.
Material	One of the non-standard compositions of the material usually occurs due to the lack of maturity of the raw material.	The properties of the slips produced from these raw materials are different or non-standard, resulting in body cracking during the production process.
Machine	There was a problem with the machine used at the time of production	Problematic engines can result in a lot of body crushing so that the accumulated body can be impacted. It can cause potential cracks.

Factor	Cause	Effect
Method	Temperature instability in the combustion engine body	Combustion engines whose temperature exceeds 1200 °C can cause cracks in the body
	Incompatibility of the production process with existing standards	Incompatibility of the methods used during the production process can result in body cracking.
Environment	Placement of tools/goods that are not following their place	The body can be hit by tools/items whose placement is not suitable, which can cause the body to break/crack
	The production area line is too narrow.	Lines that are too narrow can cause collisions between the bodies of one another.
	The abundance of dust in the production area	The occurrence of small holes when the body is not clean when entering the combustion engine

Based on the causal factors in the fishbone diagram analysis above, it will impact the occurrence of the six defects/defects in the TD42L product type. Based on the analysis results (Table 6) above, it can be concluded that the Man and Environment factors that cause body defects are the Man and Environment factors. The man factor is caused due to several errors from the operator, which include understanding, thoroughness, and caution. Fatigue and workload factors are influential factors that are the basis for the cause of the problem. With the high work target and demand from consumers, which is relatively high, the workload of the officers/employees increases and gives rise to the potential for overwork. So that the accuracy and work skills of an officer can decrease, with a decrease in work skills and accuracy of workers resulting in the process of working on products, not under standards and procedures, it is coupled with the lack of supervision and understanding of the production process which results in the exit of focus and procedures from the path that the company has determined.

Environmental factors also affect the disability of a product because in the process of production, an orderly environment will facilitate the movement of employees in the process of moving goods. Environmental hygiene factors also affect the raw materials entering the combustion process. The occurrence of body defects is not only caused by man and environmental factors, but the method factor also dramatically affects the occurrence of body defects, which indeed the method used is to use manual methods that are directly related to humans so that the production of the body often clashes during production due to narrow place conditions with a large number of operators. Thus, of several causes of body problems, it is necessary to improve to reduce body defects. If repairs are not made immediately, it can cause too many bodies and can also harm the company itself.

To carry out corrective steps on the defective product, it is assisted by 5W + 1H analysis, what, namely the occurrence of a defective body in the production process. When that is, repairs must be made immediately so that the occurrence of the body is not too long. Who is the party that can improve the production section (forming, dry body, glazing, and kama). The recommendations for improvements to reduce the product are as follows:

Man factor. It was recruiting human resources with criteria that follow the needs in order to reduce the workload borne by workers. Supervise more on the production process carried out by the supervisor of the relevant section, which aims to reduce operator errors that can cause body loss during production.

Method factor. Employees must carry out the SOPs determined by the company and their respective sections correctly so that no mistakes can cause the body to think. Providing regular training by operators in each section aimed at streamlining communication between divisions or parties involved. Structuring the tools or goods used during production correctly so that there is no collision during the production process

Machine factor. Carry out regular machine maintenance, so the machine does not have problems during production. Replacing spare parts with good quality, so the machine is not easily damaged when used.

Material factors. It is choosing materials ready for the production process so that the materials used at the production time remain following the standards determined by the company. It is marked on what materials are ready to be used for the production process.

5. Conclusion

The following conclusions are obtained based on the research that has been done. First, several factors can cause disability, including human factors influenced by lack of accuracy and lack of accuracy in the work process. The immaturity of the raw material influences the material factor. For the engine factor, there is a problem with the engine used during production and the temperature instability in the combustion engine, for the factor of the production method is incompatible with existing standards. There is an inappropriate placement of goods on environmental factors, and the production line area is too narrow. Second, proposed improvements from this research include supervision, preventive maintenance actions, and adding blowers.

This study evaluates the defects and factors causing defects in the Sanitary production process, and it is hoped that the results of this study can be applied to work in the future. For the subsequent research, what is discussed is the dominant defect only to be more detailed. The proposed improvements provided from the results of this study can later be applied in the following study to determine whether the improvement recommendations provided have a remarkable impact on the company.

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