Effect of Quality Control Circle Application to the Employee Work Productivity of PT Z

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Effect of Quality Control Circle Application to the Employee Work Productivity of PT Z

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***Abstract*: The Quality Control Circle (QCC) was first introduced by a quality control expert namely Prof. Kaoru Ishikawa in 1962 with the Japanese Union of Scientists and Engineers (JUSE). The first company to implement the concept of QCC was Nippon Wireless and Telegraph Company in 1962. This research was conducted at PT Z Company which had implemented the QCC, aiming to analyze the role of QCC on employee work productivity. Samples were taken in the Trimming cluster with nine respondents. The method used in this research is applying eight steps seven tools, solving problems following the 8 steps step and using 7 statistical tools. The results of research at PT Z found that the biggest defect is a scratch cross shaft with a total damage of 12 units/month. The dominant cause of damage is that there are no special tools for installation (the correlation factor is 0.919) and the installation process on the floor (the correlation factor is -0.832). Furthermore, after repairing it by creating special tools for cross shaft installation, which is placed on the table so that the installation is no longer done while bending, the total damage to the cross shaft scratches decreases to 0 units/month.**

***Keywords*: Quality Control Circle, defects, eight steps, seven tools.**

1. Introduction

A. *Quality Control Circle*

The Quality Control Circle was initiated by Dr. J.M. Juran and Dr. E.W. Deming and developed in Japan voluntarily, by holding a meeting periodically and continuously, to conduct a quality control activity at the workplace with using quality control tools and problem solving processes. The object of improvement of Quality Control Circle is very broad including the materials, processes, products, environment, and others. The idea of improvement can come from QCC group members, facilitators, chair of the QCC, or the leader of the company. QCC is one of the new concepts to improve the quality and productivity of industrial work services. It has proven that one of the factors of the success of industrialization in Japan is the effective application of the QCC. Because of this success, a number of developed and developing countries including Indonesia is applying QCC in industry company with intention to improve quality, productivity, and competitiveness [1].

B. *Productivity*

Productivity is a term in the production process as a comparison of input and output. Meanwhile the production process per definition can be stated as a series of activities which is needed for managing or changing a set of inputs into a number of outputs which has a value added, which is the output values that is increasing in terms of functional or economic value [2].

The production process that takes place at PT Z consists of 3 group (main departments) which is, welding, painting, and trimming. The production process flowchart is shown in Fig. 1 below.

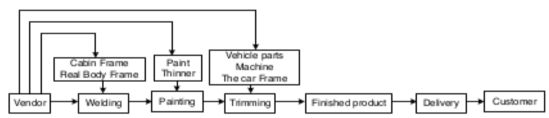


Fig. 1. Production process flowchart in PT Z

At PT Z, the defective goods become the responsibility of the company, more accurately can be called as company losses because on average the damaged goods is caused by the company rather than the supplier. This defect can be caused by the carelessness of employees, for instance, because of the damage to the machines used, causing the damaged goods, or it can be also because of the technical error in the production, or other cause, etc.

Data of defective products in September 2017 is as shown in the following tables:

Table 1
All Varian Defect of Fuso Monthly Report September 2017

defect report														
September 2017														
TRIMMING II/T/UP II														
No.	Defect	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Front axle		1		2									3
2	loose nut tire						2			1				3
3	scratch cross shaft	1	2		2		3			1		2	1	12
4	slant lable air cleaner Fuso	1	1			1	1			2				6
5	clutch pedal deep operation	1				2						2		5
6	clip pipe fuel tank damage 1 pcs	1	1		2		2							6
7	spare tire touch frame								2					2
8	loose ring nut U bolt rear axle Lh	2				1								3
9	hand brake short operation				1				2			1		4
10	steering lock not function				1		2					1	2	6
11	hose turbo intercooler not insert	2			1									3
12	bolt mud guard Rh 1 pcs		1						1			2		4
13	socket sensor speed transmission loosen				1		1							2
14	connector 2 way frame Lh gap				2					1				3

Source: PT Z

From the table above, it can be seen that the most defects are scratch cross shaft. Therefore, the research on the effect of the implementation of QCC to the employee work productivity of PT Z. is conducted. The data collection was focused in the trimming area because there are many defects found, which is the production activities in line 2 in the form of connecting or merging two or more components process, mechanically to become one unit, for example, chassis, bolt, etc.

2. Research Methods

The method used in this research is applying eight steps seven tools, solving problems following the eight steps stage and using seven statistical tools [4].

The eight steps used includes:

P (Planning) planning includes four steps:

S1: determine the main problem
S2: discuss the cause
S3: test the cause
S4: Arrange a response plan

D (Do) implementation includes one-step:

S5: Implementation of countermeasures

C (Check) examine results including one-step:

S6: examine the results

A (Action) action includes two steps:

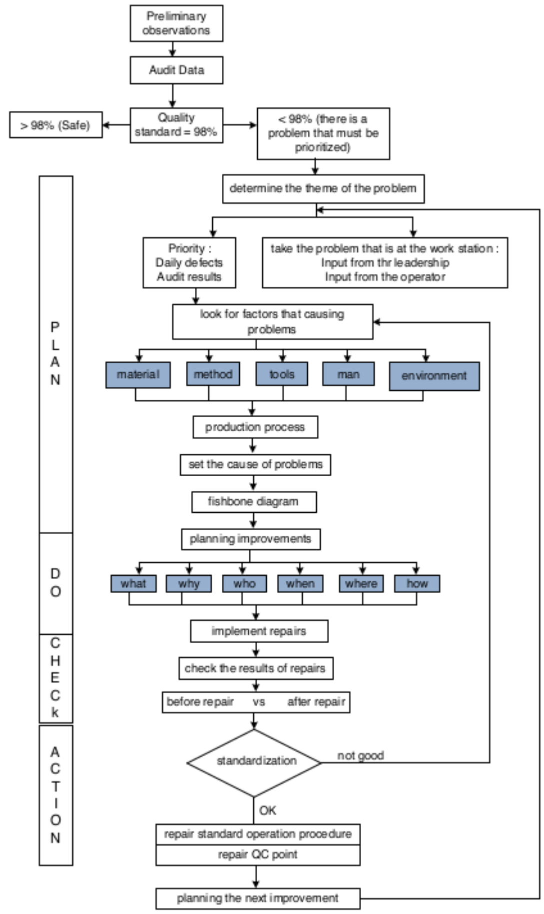
S7: Standardization
S8: Next step

While the Seven tools used includes:

1. Inspection sheet
2. Stratification
3. Pareto diagram
4. Fishbone diagram (cause-effect diagram/ fishbone diagram)
5. Scatter diagram
6. Histogram
7. Control chart

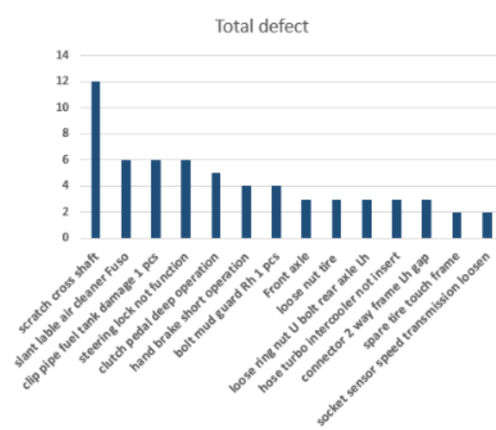
Eight steps

The steps of the quality control circle at PT Z is shown in Figure 2 below [3]:



Source: PT Z

Fig. 2. Flowchart QCC PT Z



Source: The results of author's data processing

Fig. 3. Pareto diagram of the September 2017 defect report

3. Research Methods

The following will explain one by one from the eight steps of the quality control circle at PT Z, as follows.

A. *Determine the problem*

Based on the defect data found in accordance with Table 1 above, a pareto diagram was made, shown in Figure 3 below.

From the depicted picture, the problem then is found, the point is how to reduce the scratch cross shaft defects, and the dominant damage can be seen as in Figure 4 below.

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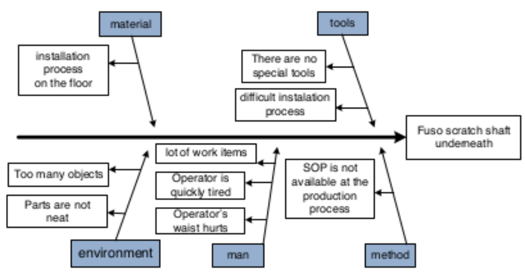
Source: PT Z

Fig. 4. Fuso scratch shaft underneath

The picture above explaining the process of cross shafts installation on the floor that cause scratches on the bottom.

B. Look for factors causing the problem

To find the factors that cause the problem, we use fishbone Diagrams, a diagram that is useful for seeing the relationship of cause effect, between the effects that occur (factor Y: scratch cross shaft defects) and all the possible causes (factor X_1, X_2, X_3, etc.). Possible causes of this diagram may consist of human, material, method, machine and environment. The results of the fish bone diagram for the case of a scratch cross shaft defect are shown in Figure 5 below.



Source: The results of author's data processing

Fig. 5. Fishbone diagram (causes-effect) defect scratch cross shaft

C. Determine the dominant cause

After finding out some of the causes of the defect, the next step is to ask members of the QCC, by giving an assessment of 1 to 5 about the factors that are suspected to be the most dominant for damage to the lower scratched cross shaft. Then, the results are presented in table 2 below.

Table 2
Suspected dominant causes (5 points) that becomes the biggest defect problem

Problem : Fuso scratch shaft underneath
Step : determination of factors that are suspected to be dominant

No.	Factor	the suspected cause is dominant	score: members of quality control circle 15	16	18	19	20	22	23	25	26	total	grade
1	tools	there are no special tools	3	5	5	2	5	2	4	5	4	35	I
2	material	installation process on the floor	5	1	4	5	1	5	5	2	5	33	II
3	man	operator's waist hurts	4	2	1	4	2	4	3	4	3	27	III
4	method	SOP is not available at the production process	1	4	3	1	3	3	1	3	2	21	IV
5	environment	parts are not neat	2	3	2	3	4	1	2	1	1	19	V
the name of the member of quality control circle			Julian D.C	Ronny E	Andrea	M Sofyan	Iwan	Abdilah H	Sena	D Saragih	Danang S	QCC	

Source: The results of author's data processing

Besides, we also needs to measure how much the contribution of the cause (factor X is the suspected cause is dominant) against the effect (factor Y is defect scratch cross shaft) by making a scatter diagram. In this research, scatter diagrams are made using a mathematical method, which is the contribution of cause to effect that is expressed by correlation factors (r_{xy}) and coefficient of determination (r^2). Correlation factors are calculated using the formula [3]:

$$r_{xy} = \frac{n\sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{\left(n\sum x_i^2 - (\sum x_i)^2\right)\left(n\sum y_i^2 - (\sum y_i)^2\right)}}$$

where:
r_{xy} = correlation between x and y
x_i = value x to i
y_i = value y to i
n = number of samples

The following is an example of calculation correlation factors cause (there are no special tools) to effect (scratch cross shaft):

Y : Effect : scratch cross shaft
X : the suspected cause is dominant : there are no special tools

No.	X	Y	X * Y	x^2	y^2
1	3	1	3	9	1
2	5	2	10	25	4
3	5	2	10	25	4
4	2	0	0	4	0
5	5	3	15	25	9
6	2	0	0	4	0
7	4	1	4	16	1
8	5	2	10	25	4
9	4	1	4	16	1
∑	35	12	56	149	24

$$r = \frac{(9*56)-(35*12)}{\sqrt{(9*149-35^2)(9*24-12^2)}}$$

r = 0.919
r^2 = 0.84

overall the results of the calculation of the correlation coefficient are presented in the table below [3].

Table 3 Correlation factors cause to effect (scratch cross shaft)

No.	problem	R	R^2	%	Summary
1	there are no special tools	0.919	0.84	33.97%	correlated
2	installation process on the floor	-0.832	0.69	27.84%	correlated
3	operator's waist hurts	-0.67	0.45	18.05%	moderately correlated
4	SOP is not availabl at the production process	-0.559	0.31	12.57%	moderately correlated
5	parts are not neat	-0.434	0.19	7.58%	moderately correlated
Total			2.49	100%	

Source: The results of author's data processing

From the depicted table 3, it is determined that there are two dominant cause of the defect cross shaft at the bottom, that is, there are no special tools and installation process on the floor, so the cluster members agree to resolve that two dominant causes.

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D. Planning the improvements

In preparing improvement plans, we must specify the 5W and 1H methods (why, what, where, who, when and how). The results of the analysis of the two dominant causes, is depicted in table 4 below.

Table 4
The dominant causes 5W and 1H

No.	Dominant causes	why	what	where	when	who	how
1	there are no special tools	so the deffect in the production process is reduced	made special tools	at workshop PT Z	Oct-17	Wenda Susanto	Figure 6. special tools
2	the assy process is difficult	so that is the assy process is easy	made special tools	Sub Assy	Oct-17	Wenda Susanto	Figure 7. The installation process is not done on the floor

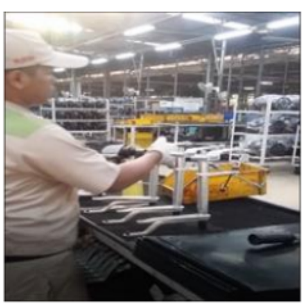
Source: PT Z

So then it is decided to make a special tools that was coated with a protector which is used to install the cross shaft so that no scratch at the bottom occurred again, and the installation process was carried out on the table so that the installation no longer done while bending.

E. Carry out repairs

In accordance with the working plan that is prepared in step 4, the special tools are made for the installation of cross shafts that are placed on the table, as shown in Figure 6 and Figure 7 below.

Source: PT Z
Figure 6. Special tools



Source: PT Z
Fig. 7. The installation process is not done on the floor

The benefits of increasing quality control cluster seen in terms of quality, cost, delivery, safety and morals are as follows:

Table 5
Benefits of improving the quality control cluster

No.	Item	The benefits of increasing from Q,C,D,S and M
1	Quality	quality is guaranteed with reduced defects
2	Cost	reduce repair cost
3	Delivery	delivery to the next station is not interrupted
4	Safety	avoid the risk of work accidents during the installation process
5	Moral	the team was satisfied because they could resolve problems on site together

Source: The results of author's data processing

The table above depicts the benefits felt by group members after completing defects that occur on the production floor. In the repairing process, there is a possibility the plan will be achieved or not achieved. This observation can be done more briefly, but it must be proportional to the observation, aside from time. In addition, the stability of improvement results is observed. If during this period of observation, the results are stable, it must be maintained, and the evaluation will be carried out for the next step.

F. Evaluate the results of improvement

In step 6, which is evaluating the results that has been done, we have to ask ourselves whether is it already in accordance with the initial planning. The following defect measurement results are displayed after making improvements as shown in table 6 below.

Table 6
Data defects for November 2017

defect report
November 2017
TRIMMING II/T/UP II

No.	Defect	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Front axle													0
2	loose nut tire						1							1
3	scratch cross shaft													0
4	slant lable air cleaner Fuso				2		2	2	1	1				8
5	clutch pedal deep operation	1			1		1							3
6	clip pipe fuel tank damage 1 pcs		2	1	1									4
7	spare tire touch frame													0
8	loose ring nut U bolt rear axle Lh													0
9	hand brake short operation						1	1						2
10	steering lock not function	2	1	1										4
11	hose turbo intercooler not insert													0
12	bolt mud guard Rh 1 pcs													0
13	socket sensor speed transmission loosen				1									1
14	connector 2 way frame Lh gap													0

Source: PT Z

Table 7
Comparison of September 2017 and November 2017 defect results.

No.	Defect	Sep-17	Nov-17	deviation
1	Front axle	3	0	-3
2	loose nut tire	3	1	-2
3	**scratch cross shaft**	**12**	**0**	**-12**
4	slant lable air cleaner Fuso	6	8	2
5	clutch pedal deep operation	5	3	-2
6	clip pipe fuel tank damage 1 pcs	6	4	-2
7	spare tire touch frame	2	0	-2
8	loose ring nut U bolt rear axle Lh	3	0	-3
9	hand brake short operation	4	2	-2
10	steering lock not function	6	4	-2
11	hose turbo intercooler not insert	3	0	-3
12	bolt mud guard Rh 1 pcs	4	0	-4
13	socket sensor speed transmission loosen	2	1	-1
14	connector 2 way frame Lh gap	3	0	-3

Source: PT Z

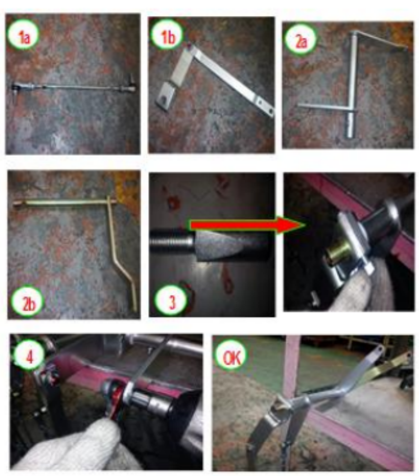
Next, we compare the conditions before the improvement with the conditions after the improvement (Table 7). The expectation is the number of defects that occur after improvements will have a significant decrease.

From table 7 above, it is seen that there is a significant decrease in defects, especially for scratched cross shafts, the number of defects becomes zero per month, meaning that solving the problem by making special tools mounted on the table is said proven to solve the problem.

G. Standardization

The seventh step is to ensure the step that has been improved can be carried out consistently and consequent in accordance with what has been standardized and carried out by all personnel related to the improvement as well as responsibility levels to the problem environment. Standardization must be written and following the standard rules. Writing standards are command nature, using short language, clear, measurable (when, how much, where), informative or easy to understand. Standards must get legitimacy from the leadership and the leader's signature is required. The leaders follows up these standards by ensuring: Standards, can and must be applied / implemented for all work units [3].

Standard operation procedure before improvement is as shown in Figure 8 below.



Source: PT Z
Fig. 8. SOP (Standard Operation Procedure) before improvement

Procedure before improvement
1. Attach the rod select (MC 411872) to the lever select (MC411372),
2. Attach the bushing (MC401563) and housing assy (MC411887X) to the cross shaft (MC418438).
3. Attach pin lock
4. Attach the rod select (MC411872)
5. Recheck again

As for, the SOP (Standard Operation Procedure) after the improvement is presented in Figure 9 below.

Source PT Z
Fig. 9. SOP (Standard Operation Procedure) after improvement

Procedure after improvement:
1. Attach the cross shaft to special tools
2. Attach the rod select (MC411872) to Lever select (MC411372)
3. Attach the bushing (MC401563) and housing assy (MC411887X0 to the cross shaft (MC418438)
4. Attach pin lock
5. Attach the rod select (MC411872)
6. Moment nut tightened
7. Read mark
8. Recheck again

The procedures above depict the important thing that must be considered for the cross shaft installation.

H. Planning for the next improvement

The eighth step is preparing the next improvement plan for the sustainability of the continuous improvement process. We determine the point and target of the point, as in the first step. However, the dominant problem number two on the previous point is possible to be the next point if the problem is still dominant, but after entering the new data. We should make a schedule of activities for the further improvement.

4. Conclusion

The production process that takes place at PT Z consists of three main departments, namely: *welding*, *painting*, and *trimming*. However, the most defects occurred in the trimming area. One of the programs carried out by management of PT Z is to hold a Quality Control Circle (QCC). QCC aims to find out the problems that occur on the production floor for a month and then look for the solutions and hopefully, new ideas can be generated and becomes evidence that the company is committed to continue to make improvements.

QCC is QCDSM (quality, cost, delivery, safety, morale), which is the basis of production. If the production system is seen as a tree, then the QCC is the root that resides in the soil.

By applying the QCC method, which is one of the kaizen culture in this company, so then it can be concluded as follows:
1. The biggest cause of defects in scratched cross shafts is that there are still no special tools for installation yet.
2. The dominant factors case are,
   a) Equipment: There is no special tools

b) Material: Doing the installation process on the floor.
c) Human: The operator's waist hurts.
d) Method: There is no SOP available at the production site.
e) Environment: The parts is not neatly arranged

3. Productivity increases with a proof that products defective reduces from an average of 12 per month becomes zero per month.

5. Suggestion

The QCC that has been applied at PT Z is already very good and it has to be maintained. The author's suggestion for perfecting the method is to correct the cause of the problem.

1. Tools: Make special tools for installing the cross shaft to be easier to do
2. Material: Cover the tools with a protector, to avoid scratching on the bottom of the cross shaft
3. Humans: To place the SOP in the production process place so that the operator knows the standardization in carrying out the work
4. Environment: Getting rid of or storing goods that are not needed in the production process.

By making continuous improvements, the company can maintain the quality standards set by the company.

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