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IMPROVEMENT BONDING QUALITY OF SHOE USING QUALITY CONTROL CIRCLE

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Abstract -- *Shoe industry development in the era of globalization is currently overgrowing. Therefore, every company should be able to compete strictly with other companies that produce the same products. Quality maintenance is having to be done by the company to survive in business competition. PT. ABC is a manufacturer of sports shoes. The company has a problem with bonding shoes not achieved company standard in the year 2017. This paper is focused on the improvement of bonding shoe quality by using a method of Quality Control Circle which applying quality control tools are like check sheet, Pareto diagram, fishbone diagram, and 5W + 1 H. Based on the research results obtained percentage improvements of quality bonding test of 21.15%. Cement stripping on the midsole is the most significant number of the bonding test failure in Laboratory that is as much as 26.33% or 218 prs from the total collapse of the overall bonding shoes. Based on the background, the purpose of this research is to find out the root causes of the failure of bonding test shoes. The limitations of this research are only improving processes in the department, which makes the bonding shoe quality does not achieve the company standard. After doing the analysis using the quality control tools and making the improvement process in the whole areas that the percentage of the bonding test cement stripping on midsole could be increased to 5.18%. Analysis of the results obtained by applying the method of Quality Control Circle is the improvement of the quality of the bonding shoe. So, the trust customers against the company may be obtained that would eventually increase the number of orders to the company.*

Keywords: *Quality Control Circle; Bonding shoes; Stock fitting process; Quality control tools*

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INTRODUCTION

PT. ABC is a company that produced sports shoes (Triana & Beatrix, 2019). The company has a problem of quality bonding shoes which did not meet the company target in the year 2017. The bonding test result percentage of finished shoes in the year 2017 is 78.6%. The objective of the company is 98%. Currently, process monitoring of the quality control system's only focused on some department, not for the whole department. The company used the PDCA (Plan, Do, Check, Action) cycle method to solve the bonding problem (Mukherjee, 2019).

Quality control can be done using the concept of the PDCA cycle, which was introduced by Dr. W. Edwards Deming, an expert in quality control. Therefore, it is known as the cycle of Deming (Deming, 1982). PDCA cycle is a process for continuous improvement, has no beginning or end (Agrawal, 2019; La Verde et al., 2019; Herjanto, 2017).

The quality of the bonding is determined by the results of the work of the entire department. The process is starting from the design phase up to the assembly process. Therefore, researchers applying the quality control circle method for solving bonding problems.

Some references of journals that discussed for improving the quality product using the PDCA cycle. Sari et al. (2018) with research using methods a cementing process stock for fitting bottom shoes running utilizing the technique of PDCA in each process and then analyze the test results with adapting the bonding quality control tools. Another method that can be used to identify the problem, eliminate or reduce potential failure, or reject a product is FMEA (Kholil & Prasetyo, 2017). Therefore authors choose methods of QCC (Quality Control Circle) (Nemer & Vieria, 2018; Xia et al., 2016) to improve the quality of bonding shoes desired by the company.

This research aims to find out the root cause of the bonding shoe failure and how to

monitor the quality of the bonding shoes in daily operation.

MATERIAL AND METHOD

Material

According to Wignjosoebroto (2003) Quality Control Circle is a small group of employees, sometimes lead by a supervisor who will voluntarily find ways to improve the quality and reduce production costs in the production system. According to Ishikawa (1983), Quality Control Circle is a small working group that voluntarily works to carry out quality control

The positive thing that will also grow along with the development of QCC activities is the creation of a very supportive work atmosphere and encourages employees to explore their creativity and potential continually. It is given that the purpose of this QCC is to optimize assets owned by companies/institutions, especially skills development and the workers themselves better and respect human values and create a conducive workplace, to improve quality in the broad sense and growth of the company. Besides, the application of the QCC is also a tangible form of involvement of all parties. In this case, those who are in lower management, the improvement and development of companies/organizations. The goals to be achieved through QCC activities include: reducing work mistakes and improving quality, improving better cooperation, and increasing employee awareness in carrying out their duties. Besides, training employee skills in solving problems they face, instilling awareness about the importance of prevention from the beginning, developing a more harmonious and communicative relationship between the manager and his employees, encouraging personal development and leadership. This goal was caused by ignorance and lack of management knowledge identifying problems, how to find out the root cause, and how to improve the bonding quality problems that occur.

The manufacturer's perspective and the perspective of customers will be met on the use of customer (fitness for customer use), so the suitability between customers with customers that can result in a mutually agreed standard and can meet needs and expectations of both sides (Maysaroh & Husein, 2015).

Development of quality control the inspector's activities are enhanced by various statistical methods (Riyanto, 2015).

1. Quality Control Operator Stage. This stage is when the operator is responsible and does all the tasks of determining the quality of a product as a whole.
2. Foreman Quality Control Stage. This stage is when the foreman holds all the tasks of quality control.
3. Inspection Quality Control Stage. This stage is when doing all the tasks of quality control.
4. Statistical Quality Control. Stage This stage is when various statistical methods enhance tasks that are usually centered on the inspector's activities.
5. Total Quality Control stage. This stage is used in the production floor, all team from superiors until subordinates are responsible for quality control tasks there is.

Method

The methodology in this study is shown in Fig. 1. In Fig. 1, the quality control process that is using check sheet, Pareto diagrams, fishbone diagrams, and 5W+1H.

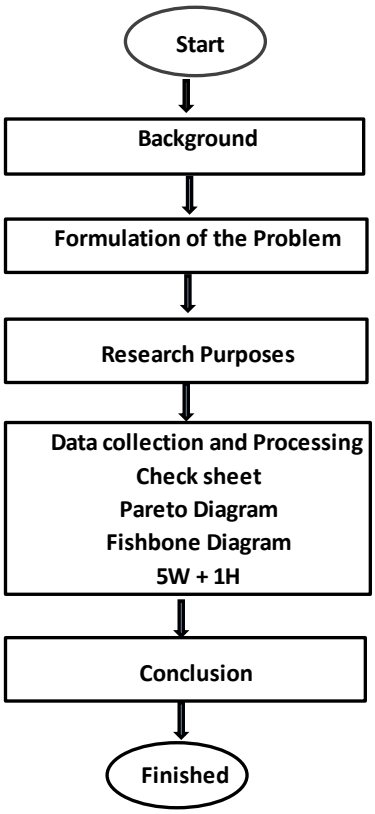

Figure 1. Flowchart Methodology Research

In this study, the method used is the Quality Control Circle. Because the Quality Control Circle method focuses more on controlling product quality in making improvements with the PDCA and Seven tools cycles, also, this method was chosen because it has structured and measurable steps in solving problems, so that based on existing data and facts, improvements can be made. Because of the implementation of Quality

Control Circle is needed to know the cause of a problem and get a solution to solve the problem. The background of the existing problems, an observation of the current product quality control is done to minimize bond test failure at PT ABC. The objectives to be achieved in this study to determine the causes of dominant and non-dominant defects in the products in PT ABC and determine the improvements that must be made to minimize the number of consumer complaints with the Quality Control Circle (QCC) method.

The data used in this study are laboratory test data of PT. ABC relating to product quality on bonding shoe test. The test is done where field observations are carried out to observe firsthand how the shoe production process on stock fitting and assembling by ensuring the bonding process of the bottom of the finished shoes (outsole and upper) part of the shoe running in accordance with Bonding Flowchart process that has been approved by the customer/buyer.

The method used in sampling (sampling) shoes to be tested in the Laboratory is 0.004% of the monthly production following customer/buyer standards. The observations at the Laboratory of PT. ABC can be taken secondary data in the form of the number of bond failures on the testing of shoes every month. So, it is hoped that solutions can be found to minimize bond failure in the shoe product.

After the data has been collected and has been identified, then the data is processed according to the purpose of solving the problem. The data processing steps include:

1. Calculating the frequency of bond test failure in the Laboratory for improving the production process.
2. Make an improvement plan using the 5 W + 1 H method which will later be made a matrix containing the purpose of improvement, how to improve, time of implementation, area of development and person in charge of each improvement activity.
3. They are monitoring the repair process, whether the improvement is by the plan or not. The aim is to collect, and document data or records regarding implementation, which include conditions before development and after repairs are carried out. This documentation will be used as data or basis in the evaluation phase of the results of improvements. The implementation of this improvement will later be found a solution to the existing problems.
4. Evaluate the results of improvements made to determine whether or not the improvements have been implemented.

Next analyzing is bond test system in the Laboratory. It was starting from picking up the sample from the production floor, doing the bonding test, evaluation bond test result and released the bond test result by Laboratory Manager. Then, Lab Manager submitted the bond test report to Quality Director and Production Management, as seen in Fig. 2.

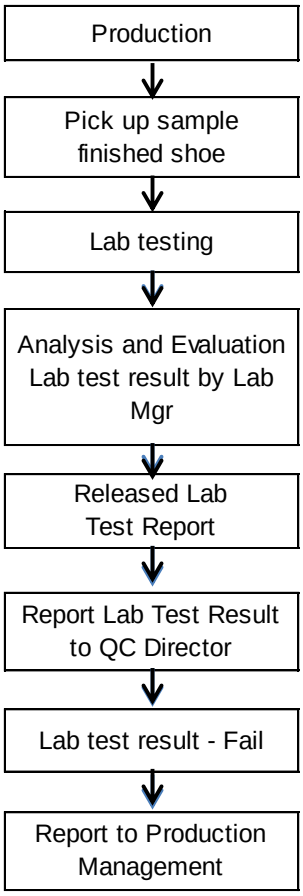

Figure 2. Flowchart Laboratory Bonding test

RESULTS AND DISCUSSION

Production Process

The production process of PT. ABC is divided into two departments, namely: Stock fitting Department is the part that works on attaching the rubber sole to the midsole.

Assembling Department is the part that works on attaching the outsole to the upper.

To ensure the production processes of the installation of the components mentioned above will run correctly and consistently so that it will produce quality shoes by company standards, then PT. ABC provides the bonding process flowchart before run mass production.

The Bonding Process Flowchart for the stock fitting department and assembling department, as seen in Fig. 3, and Fig. 4.

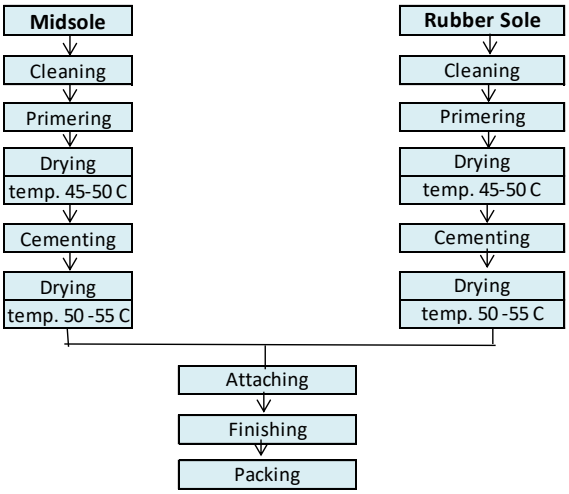

Figure 3. Stock fitting Bonding Process Flowchart

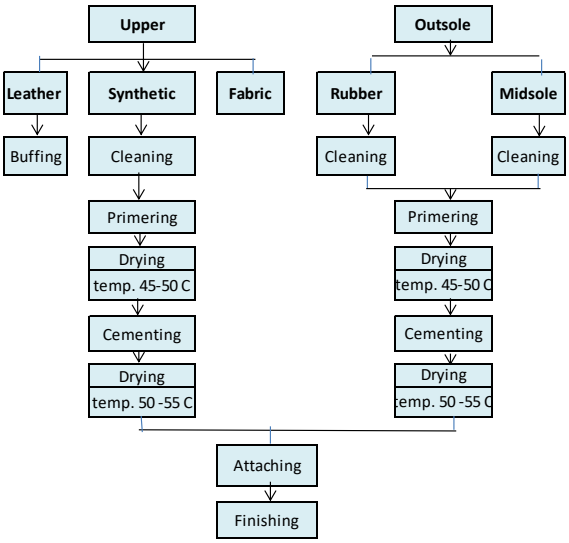

Figure 4. Assembly Bonding Process Flowchart

The following is the new working system after formed team Quality Control Circle (QCC) to find out the root cause of the problem in bonding test that does not meet specifications of the customer. Team Quality Control Circle make a bonding test using the tools of quality control, can be seen in Fig. 5.

Establishment of the QCC team

The QCC team is essential in supporting the smooth running of research, especially to find a problem and a solution. The formation of this team consists of 5 to 10 people and in one job. There are several ways to allow greater employee participation, but the more accepted and practiced one is the creation and utilization of a Quality Control Circle (Urubio, 2016).

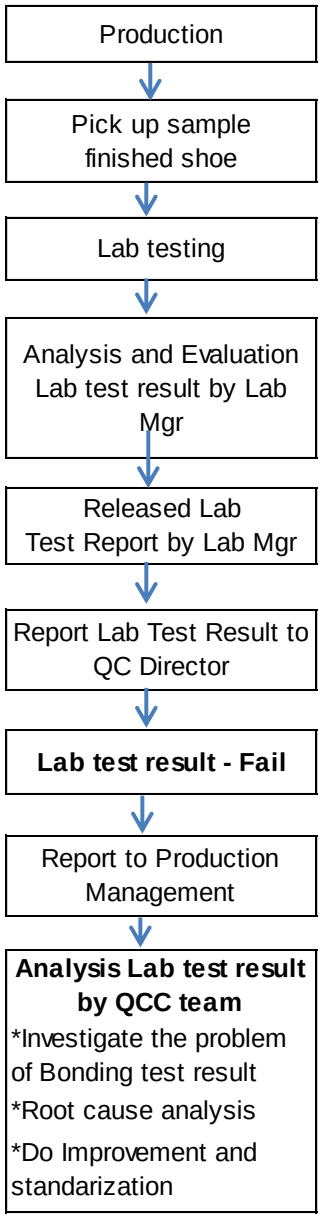

Figure 5. New Process Flowchart Laboratory Bonding test

The tasks of the QCC team are:

1. The facilitator, in charge of facilitating every activity in the QCC and giving input and motivation to the team.
2. QCC Leader, as the head of the QCC team who is in charge of chairing each team meeting and motivating members if there is a decline in each activity.
3. Team Leader should be responsible for leading each meeting and presenting the results of the meeting if the company wants.
4. Minutes, record all meeting results obtained from each activity.
5. Members, in charge of giving suggestions, solutions, and finding problems in work to serve as themes.

Critical To Quality (CTQ) Determination

Critical to Quality Determination (CTQ) is performed for attribute characteristics. This is performed because consumers (internal consumers) often provide complaints against various types of bond failure. Shoes that qualify for internal consumers (stock fitting and assembling departments). In addition to multiple types of bond failures that function as CTQ (famous for quality), that is by choosing various types of bond failures that are most dominant. Because of the nature of bond failure that significantly affects the results and quality of the product.

The types of bond failure after the laboratory test determined by the customer/buyer are as follows:

- Material failure. Indicates material failure in laboratory tests that do not meet bond specifications.
- Cement film splitting between the upper (upper part of the shoe) and outsole (bottom part of the shoe). Indicates that there is glue on the upper and outsole.
- Cement film splitting between midsole and rubber sole. Indicates that there is glue on the midsole and rubber sole.
- Cement stripping of the midsole component Indicates that there is no glue on the midsole.
- Cement stripping from sole rubber components Indicates that there is no glue on the outsole.
- Cement stripping from the upper component Indicates there is no glue on the top.

The percentage of the bonding test result from January-December 2017 is listed in Table 1.

Table 1. Percentage of Bonding Test results 2017

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Average
%	65.3	62.3	73.0	78.6	72.3	73.7	76.7	79.7	83.4	92.5	92.5	94.0	78.7
Standard	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0

The data in Table 1 shows the bonding test results in 2017 are below the company standard. For this reason, the researchers want to make improvements by using the Quality Control Circle method. To make it easier for repairing, an analysis of the type and amount of bond failure is highest in 2017. The following are data types and bond failure amounts in 2017 as analysis data for corrective actions.

From the data in Table 2, a Pareto diagram is made to determine the type of bond test failure on the most significant percentage of shoe bonding. Table 3 shows a calculation of bond failure in 2017.

Table 2. Type and Amount of Bond Failure in 2017

No	Type of Bond Failure	No of Bond failure (prs)												%
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
1.	Cement stripping from the	35	21	34	25	18	7	24	21	25	31	25	15	26.3
2.	midsole.	32	23	38	16	23	5	20	14	30	32	22	19	52.0
3.	Cement splitting between upper and midsole	31	18	29	18	27	6	17	17	21	35	26	11	76.0
4.	Cement stripping from upper	29	23	19	15	24	4	25	15	19	32	0	9	97.8
5.	Cement stripping from the	2	1	4	0	3	2	1	3	1	4	2	0	100
	outsole	129	86	124	74	95	24	87	70	96	134	75	54	
	Material failure													
	Total													

Table 3. Bond Failure Types 2017

No.	Type of failure	No of bond failure (prs)	%	Cumulative (%)
1.	Cement stripping from the midsole.	281	26.3	26.3
2.	Cement splitting between the upper &	274	25.7	52.1
3.	midsole	256	24.0	76.0
4.	Cement stripping from the upper	233	21.8	97.8
5.	Cement stripping from the outsole	23	2.2	100
	Material failure			

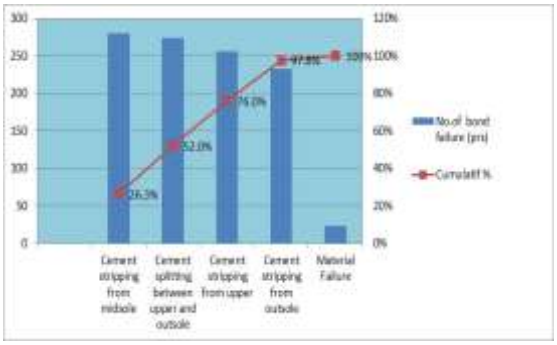

Figure 6. Diagram Pareto Bond Failure Jan–Dec. 2017

From the results of the calculation, the Pareto rule 80-20 be applied in deciding which part on the results of the test give the bonding influence significantly to bond failures. The results of diagram Pareto in Fig. 6 shows the type of bond failure is cement stripping from the midsole. The analysis will then be carried out using a fishbone diagram to find out the root cause of the bond failure cement stripping from the midsole.

Fig. 7 shows a fishbone diagram to find the potential cause of bond failure cement stripping from a midsole.

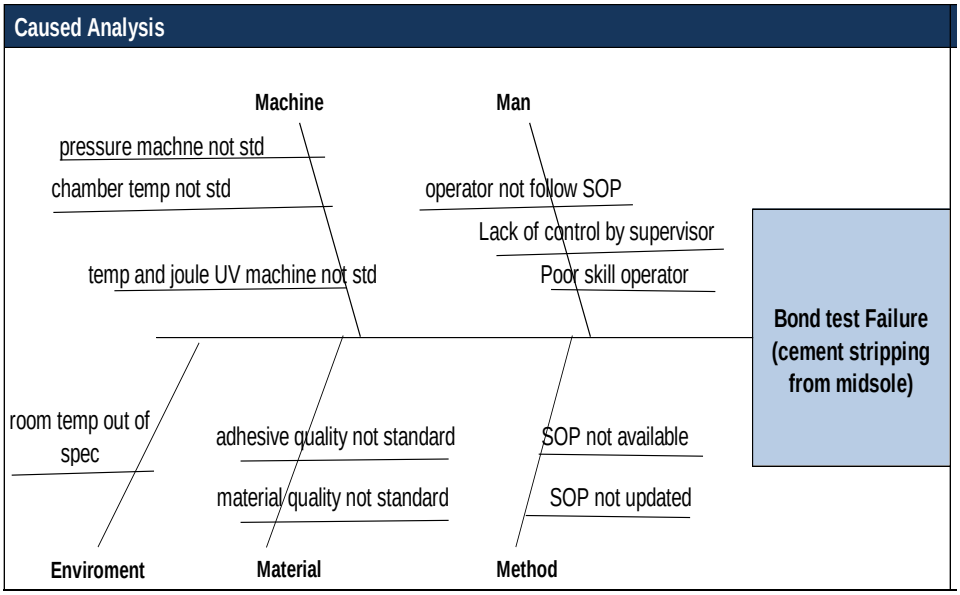

Figure 7. Fishbone Diagram

Fishbone diagram above is part of the seven tools that are used to analyze the causes of the main problems that occur at PT. A B C. In this study, it was found that bond failure cement stripping from midsole that occurs in the stock fitting production process. From the base of this problem will be analyzed the causes of the occurrence of this problem so that the main root problems are obtained which are then considered whether the corrective steps for this matter.

Following the results of the analysis using the Pareto diagram, it is known that the most significant defect is dominated by cement stripping of the midsole.

The following is an explanation of 5W + 1H for the planned failure of bond failure cement stripping from the midsole:

What: Make improvements to man, machine, material, method, and environment.
When: Repair was done in January 2018
Who: Team QCC.
Where: The problem occurs in the stock fitting production process of PT. ABC
Why: For the issue of bond failure cement stripping in the midsole to be improved immediately on some potential causes of the problems (man, machine, material, method, and environment)
How: Make improvements to each object of the problem.

Table 4 lists an improvement planned of bond failure cement stripping from midsole in the stock fitting department.

Table 4. Improvement Plan uses 5W + 1H in the Stock fitting Section

No.	Possible Causes		What	Why	Where	When	Who	How
1.	Machine	Joule UV m/c is not fit the standard	Setting Speed machine	For making UV joule m/c has fit the standard	Stock fitting	Jan 2017	Team QCC	Check UV joule machine on regular basis
		Temp machine chamber is not fit the standard	Repair machine	For making temperature chamber machine fit the standard	Stock fitting	Jan 2017	Team QCC	Check machine condition daily
2.	Men	The operator does not follow the SOP	Training operator	The operator should be followed SOP	Stock fitting	Jan 2017	Team QCC	Training and monitoring operator
		Operator less training	Provide a training plan	The operator should be trained regularly	Stock fitting	Jan 2017	Team QCC	Training operator on a regular basis
3.	Method	SOP not updated	Update SOP	The process should be followed by the standard	Stock fitting	Jan 2017	Team QCC	Check SOP in all areas
		SOP not available	Provide SOP	The operator should be followed SOP	Stock fitting	Jan 2017	Team QCC	Check SOP in all areas
4.	Material	Quality of material out of spec	Check the quality of material before using	Ensuring quality of the material should be followed the spec	Stock fitting	Jan 2017	Team QCC	Doing a physical test of material/raw chemical in Lab
		Quality adhesive out of spec	Check the quality of adhesive before using	Ensuring quality of chemical should be followed the spec	Stock fitting	Jan 2017	Team QCC	Doing a bond test in Lab by daily basis
5.	Environment	Room temp out of spec	Repair room temp	Ensuring room temp follow the standard	Stock fitting	Jan 2017	Team QCC	Checking room temp on a daily basis

The improvement of bond failure cement stripping from the midsole using 5W + 1H in some dominant causes as in the table above will facilitate the monitoring process.

Furthermore, the study continued with evaluating the results of improvements by analyzing the percentage data of bond failure cement stripping from midsole during 2018.

The percentage of bond failure cement stripping from midsole in the year 2017, as shown in Table 5.

The data in Table 5 shows that the number of samples tested and the number of bond failure cement stripping from the midsole that has been carried out at the Laboratory of PT. ABC in 2017 is an average of 26.33% can be seen in Table 6.

Table 5. Percentage of bond failure cement stripping from midsole 2017

Month	No of sample (prs)	No of failure (prs)	%
Jan	129	35	27.13
Feb	86	21	24.41
Mar	124	34	27.42
Apr	74	25	33.78
May	95	18	18.95
Jun	24	7	29.17
Jul	87	24	27.59
Aug	70	21	30.00
Sept	96	25	26.04
Oct	134	31	23.13
Nov	94	25	26.60
Dec	54	15	27.78

Table 6. Percentage of bond failure cement stripping from midsole before improvement 2017

Before improvement		
No of samples (prs)	No of Bond failure (prs)	%
1067	281	26.33

After doing improvement using the Quality Control Circle method, the data is then collected and evaluated. As can be seen below, the percentage of bond failure cement stripping from the midsole has decreased only by an average of 5.18% in 2018.

Table 7. Percentage of bond failure cement stripping on midsole after improvement 2018

After improvement		
No of samples (prs)	No of Bond failure (prs)	%
1253	65	5.18

The results of the data processing as seen in Table 6 and Table 7 above, bond failure cement stripping from the midsole before improvement in the year 2017 and bond failure cement stripping on the midsole after improvement in the year 2018. It can be seen that there is a decrease in the percentage of bond failure cement stripping from the midsole become 21.15%.

CONCLUSION

Based on the processing and data analysis of this study, the conclusions of the researchers as follows. The essential type of bond failure is cement stripping from the midsole. Process improvement of the bond failure cements stripping from the midsole using the 5W + 1H. The results of cement stripping from midsoles are increased to 21.15% in 2018. The method of Quality Control Circle is very useful to apply because all teams could be directly involved in the whole processes for improving the quality of bonding shoes.

REFERENCES

Agrawal, N. M. (2019). Modeling Deming's quality principles to improve performance using interpretive structural modeling and MICMAC analysis. *International Journal of Quality & Reliability Management*, 23 pages. https://doi.org/10.1108/IJQRM-07-2018-0204

Deming, W.E. (1982). *Out of The Crisis Quality, Productivity and Competitive Position*, Cambridge University Press. USA.

Herjanto, E. (2017). *Manajemen Operasi*, Gramedia Widiasarana Indonesia. Jakarta http://doi.org/10.22441/sinergi.2017.1.008

Ishikawa, K. (1998). *Tehnik Penuntun Pengendalian Mutu,* MediyatamaSarana Perkasa, Jakarta.

Kholil, M. & Prasetyo, E (2017). Tinjauan Kualitas Pada Aerosol Can *Ø 65 X 124* dengan Pendekatan Metode Six Sigma pada Line ABM 3 Departemen Assembly. *SINERGI*, *21*(1), 53-58. http://doi.org/10.22441/sinergi.2017.1.008

La Verde, G., Roca, V., and Pugliese, M. (2019). Quality Assurance in Planning a Radon Measurement Cycle Approach: What Improvements? *International Journal of Metrology and Quality Engineering*, *10*(2), 6 pages. https://doi.org/10.1051/ijmqe/2019004

Maysaroh, A & Husein, T. (2015). Perbaikan Kualitas Anti Nyamuk Aerosol Produksi PT. XYZ dengan menggunakan Metode Quality Function Deployment (QFD). *SINERGI,19*(2), 85-90. http://doi.org/10.22441/sinergi.2015.2.003

Mukherjee, S.P. (2019). Improving Process Quality. *Quality*. India Studies in Business and Economics. Springer, Singapore. https://doi.org/10.1007/978-981-13-1271_9

Nemer, K., and Vieria, R.K. (2018). The relation between the traditional quality and the change of organizational culture using as methodology the quality control circle. *International Journal of Productivity and Quality Management, 23*(2),

163-186. https://doi.org/10.1504/IJPQM.2018.089155

Riyanto, O. (2015). Implementasi Metode Quality Control Circle Untuk Menurunkan Tingkat Cacat Pada Produk Alloy Wheel. *JEMIS, 3*(2): https://doi.org/10./ub.jemis.2015.003.02.7

Sari, et all. (2018). Pengaruh Mutu Proses Stockfit Terhadap Hasil Uji Bonding Bottom Sepatu Running Dengan Metode Cementing di Perusahaan Sepatu Olah Raga Karawang-Jawa Barat. *e-Jurnal ATK*, 36-50.

Triana, N.E. & Beatrix, M.E. (2019). Production System Improvement Through Kanban Application in Labor Intensive Company. *SINERGI*, *23*(1), 33-40. http://doi.org/10.22441/sinergi.2019.1.005

Urubio, M.L. (2016). The Effects of Quality Control Circle on Employee Perceptions and Attitudes in Selected Companies: Kingdom of Bahrain. International Advanced Research Journal. 3(1). http://doi.10.17148/IARJSET.2016.3123

Wignjosoebroto, S. (2003). *Pengantar Teknik dan Manajemen Industri*, Guna Widya, Jakarta.

Xia, S., Yu, C., & Zhao, T. (2016). Quality Control Circle Application in the Surgical Instrument Traceability for Security Management. *Annals of Clinical and Laboratory Research, 4*(2), 1-5.