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A Systematic Literature Review of Implementation Quality Control Circle in Manufacturing and Services Industries

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A B S T R A C T

A quality control circle (QCC) is a group of workers who do the same or similar work, who meet regularly to identify, analyze, and solve work-related problems. This paper is a literature review on the role of QCC in enhancing work safety in the manufacturing and services industry. This paper explores how quality control circles (QCC) enhance work safety in a firm manufacturing environment. The method used is reviewing inquiry papers that use QCC consistently. The findings of this study can be considered as a roadmap for the successful implementation of QCC in all industries. The results obtained contribute to advances on QCC research for identifying that the concepts sustainable of quality manufacturing and service industries can enable quality to have positive impacts on all the sustainability dimensions in an integrated way, and also supporting the implementation of the quality plan in the following aspects: continues improvement; quality management; management improvement. In essence, these research results will help management make crucial decisions and resource allocations required to make the QCC implementation a succes.

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1. INTRODUCTION

This paper discussed organizational learning, which defined behavioral and cognitive learning, where team members could change their thoughts and behavior after participating in quality control circle activities. According to Crossan, Lance, and White (1999), learning involved different individual, group, and organization levels, learning through QCC activities based on this definition. Learning starts from the individual (Wang and Ahmed, 2003), and individual learning outcomes from the members of QCC can be integrated into group and organization levels.

Organizational learning concepts provide useful ways of thinking about quality control circles. Another quality improvement more holistic process towards learning suggests that improving and developing behavioral routines will be more beneficial. In recent years, theworld's

manufacturing and service industries faced tremendous changes and challenges due to a newly-established National Health Insurance policy and thegovernment's deep involvement. Health care industries had their limitation in finance and management. Thus, quality improvement has become important to any industry, and quality control circle (QCC) was one of the most popular total quality management (TQM) tools used in the industries. Most of the QCC has been focused on performance and leadership, but its application in organizational learning and group learning remained unnoticed. According to (Tobergte & Curtis, 2013), the aim of quality improvement activities was not only on efficiency and cost but also about learning and management.

Based on their research, most employees thought after participating in QCC activities, and they would have higher productivity and competency. And QCC members thought it brought more opportunities to help them learn, especially on creativity and innovation. Lin et al. (2002) suggested that every modern hospital faced challenges from the government and health care environment. For those reasons, TQM and customer satisfaction management (CSM), and quality improvement tools became more important these days. Garvin (1993) also mentions that organizations have effectively created or acquired new knowledge and applied it to their activities. Therefore, learning organizations can improve the motive power, integrate individual knowledge and skills into organizational competence, and create competitive advantage. The discussion of organizational learning theory and quality theory in this study discussed QCC learning and its contribution to many focus industries. It also provided evidence that quality control circles can facilitate organizational learning in the quality context.

In this study, the authors first conducted a comprehensive literature review. The literature was focused on quality management, quality control circles, organizational learning, and health care administration. Secondly, the authors collected empirical studies on industries with a quality control circle approach from 2016 to 2020, including 30 quality control cycles kinds of literature. We used any journal database in the national and international to collect that related literature. The authors identified four concepts and practices within the existing literature intuiting, interpreting, integrating, and institutionalizing and their linkage to QCC activities.

The primary purpose of the regular meetings among the team members is to achieve customer (internal and external) satisfaction through continuous improvement and teamwork. To achieve this result, the members need to understand the customer's role and the organization's involvement and commitment. In other words, to be successful, the initiative requires intense focus on customers and business processes, a strong spirit of continuous improvement, coordinated teamwork, and proactive employee participation.

2. RESEARCH METHOD

The literature survey consists of thirty papers explaining the people are trained to structure problem identification, evaluation, solution, and presentation stages, and use associated techniques its scope (Fig. 1). This survey is going to review different QCC which are used in some scale industries. Various of this survey explains the importance of QCC tools. This review journal takes from many resources such as Google Scholar; Researchgate; Academia; Science Direct, Proquest, etc. Where keywords are used "quality control circle in several industries" in this paper is QCC tools in some industries.

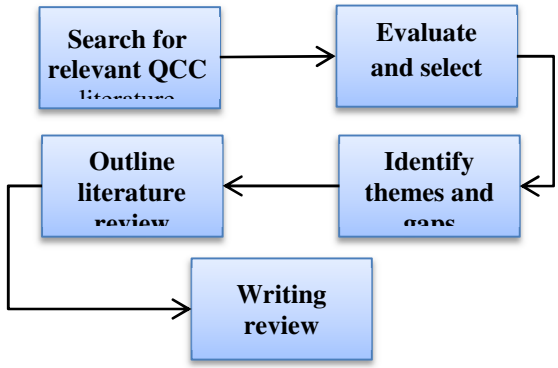

Fig. 1. Conceptual framework literature review of QCC

3. RESULT AND DISCUSSION

Research Tobergte & Curtis (2013) focused on health care, and medical care researchers were concerned about QCC activities' performance. According to Lam et al. (2005), the aim of quality improvement activities was not only on efficiency

and cost but also about learning and management. Based on their research, most employees thought after participating in QCC activities, they would have higher productivity and competency. In this study, the authors discussed organizational learning through QCC in Taiwan's healthcare industry and identified the association between organizational learning and QCC activities. It is anticipated that the present work can provide a different perspective on quality improvement and organizational learning theory.

This research aimed to understand better the QCC activities that could bring different learning perspectives and behavioral changes. The authors first assorted literature based on different purposes, then analyzed those QCC activities appearing in the literature through 4Is. They provided different outcome perspectives from traditional quality improvement views. QCC team could prove an effective vehicle for organizational learning because it provides a minimum critical mass for the cross-fertilization of ideas and developing its learning norm.

We believed that organizational learning in the healthcare industry research field had many potential opportunities. First, in clinical and managerial practice, continuous quality improvement (CQI) and total quality management (TQM) can reinforce employees' working ability, skill, and knowledge. Second, the performance research perspective might help organizations develop an appraisal system, but individual and group learning are also important to organizations. Third, through quality control circles activities, most employees could learn and inspire new ideas of quality themes and important organizations' important competence. In this review paper, the authors were only reviewing literature through cross-section research.

Syobir & Aulawi (2016) has researched companies engaged in the rubber industry PT Mandala Logam is a company engaged in the production manufacture of products that are the basic material of rubber, and one of the products that are often made is the product of Rubber Sandals. In the manufacture of these products, the materials are supplied from the Nusantara Rubber Plantation company (PT PN) and the local community to meet production needs. Products that are often made by PT Mandala Logam are Rubber Sandals products because this product is made to meet market demand and from a large company, namely, PT Maspion, where the product of Alas Sandal Karet (Rubber Sandals) has a high order level, where the company only produces if there is an order. Hence, the company focuses on producing Rubber Sandals products. The effect of defective products on the company impacts quality costs, company image, and customer satisfaction. The more defective products are produced, the greater the quality costs incurred. This is based on the higher quality costs made on faulty products, inspection, rework, and so on will appear.

Based on the results of data processing using testing in proportion rejection from the milling machine is 8%, the proportion of rejection from the Oven Mill machine is 9%, and from the press machine is 10%. This is bigger than the company's average proportion, which means that the production process is not running well. To find out the most dominant characteristics of the disability, a Pareto diagram analysis was performed.

Bachtiar, Parwati& Susetyo (2013) aim to get solutions to minimize waste and determine the amount of savings obtained, and also it can be used as a reference for group members in terms of data presentation, data collection methods, and the determination of new circle time in the manufacturing industry. The process observed is the finishing process and the assy part of the air intake duct due to its work layout, which is easy to change. The assy processes previously located in the 2nd process department will be combined into one layout with the production department's finishing process.

After the object of observation has been determined and the problem has been formulated, steps then analyze the cause and effect using a fishbone diagram. The fishbone image is shown in Figure 1. From the calculation results, it is found that the three most dominant factors are based on the assessment of each member. These three factors include: First, the process is located in a different department. The finishing and assy processes are located in a different department, including material handling, bottleneck, and middle. This causes time to waste, resulting in high production costs. Combining these two processes will save a lot of time so that waste can be minimized as optimal as possible.

QCC implementation is needed to determine the cause of a problem and find a solution to solve it. The cost savings obtained after combining the finishing and assy processes into one work layout are IDR 27,958,603.84. The new circle time for the new finishing and assy process is 57 seconds. Supriatin (2018) in Department of Work Shop Engineering PT. Muliakeramik Indahraya Tbk regularly convened Quality Control Circle (QCC) and strengthened the work culture with self-motivation exercises to improve employee performance.

From the overall results of the t-test, it can be concluded that the two, namely QCC and Work Culture, have quite an effect on employee performance. From the ANOVA test or the F-test value, the F count is 0.190 with a significance of 0.828. the required significance value is accepted less than 0.05. because 0.000 <0.05, it can be said that the QCC variable and the Work Culture variable together (simultaneously) are quite influential on employee performance variables. Kartika & Junaedi (2019) about analyzing herbal medicine products' quality improvement from microbial contaminants. Therefore, it is necessary to improve the quality and process of herbal medicine using the PDCA method. QCC approach is conducted in one of the herbal medicine producers. Some problems often arise in the processing of traditional medications, namely contamination. In general, the meaning of contamination is the placement of material that is not important in the person's body, environment, food or other ingredients. According to world health organizations, contamination can be caused by chemicals, biological or radio nuclear.

In this study, the researcher will discuss the improvement and control of herbal powder products' quality as one of the traditional drinks to reduce microbial contamination according to the standard limits allowed by the Indonesian National Standard (SNI). Quality control is needed here to improve and maintain products under predetermined product specifications. The method used in this study uses the PDCA method (Plan, Do Check and Action), using the PDCA method to systemize continuous action within an industry. The Quality Control Circle (QCC) approach is also used for useful quality improvement. QCC is more effective in improving quality because implementing repairs can be done directly by the operator concerned to reduce the decline in quality (defect) and increase improvement significantly. From the results and discussion in the research above, the conclusions drawn are from the results of the highest sampling of microbial contamination occurring in NTPS products with an average value of ALT contamination of 15 x 103 col/g and for AKK contamination of 5.67 x 102 col/g. From the results of the analysis carried out with the PDCA method with the QCC approach, several efficiency results were carried out, namely: reduce microbial contamination to increase product expiration, improve the safety of workers in the production section, can save costs (costs for the company).

Hipni et al. (2019) explain that After using the PDCA using the Eight- Step Improvements, Seven Tools and QCC (Brainstorming Techniques), 5Why, 5W3H), and the QCC team found that the main cause was lack of response to customer quotes, lack of salespeople and lack of consulting skills. This study was conducted in the sales department at PT. KMI, where sales departments form QCC groups consisting of 3 persons and one person acting as facilitators. The QCC aims to improve the sales department's performance in overcoming the factors that fail to achieve sales targets. Improvements and analysis steps are carried out in the PDCA cycle, using the 8-Step Improvements (8-Step Repair) and assisted with 7 Troubleshooting Tools (7 tools).

The corrective measures to be taken make the follow-up a procedure of the customer's offer, suggesting sales people's addition to HRD and training skills training to salespeople and marketing staff. After the PDCA cycle is carried out with eight levels of improvement and the aid of seven problem-solving tools, the result is a QCC team, and the sub- marketing section can achieve an average monthly sales increase. The standardization results are made so that the sales and sales force in this subdivision must implement standard procedures in performing sales activities. In this activity, Standard Operating Procedures are made regarding follow-up offers and consultancy training skills.

Sumarta & Anaperta (2019), about the mining industry, explains that A production management study was carried out by applying the Quality Control Cycle (QCC) method. This method makes

it possible to evaluate heavy equipment performance and the obstacles experienced during the production process. The study begins by recalculating the initial conditions by considering its mining equipment, namely Excavator CAT 330 and DT Hino FM 260 JD. The actual productivity of 1 unit of Exca CAT 330 reached 74,113 tons with 80.66% utility equipment, and DT Hino FM 260 JD reached 41,607 tons with 4 DT units with 79.32% utility equipment, machine match factor reached 0.48. After evaluating the Fishbone Diagram, four main problems, namely external factors, environment, equipment, and manpower, affect work time. Performance improvement recommendations Pareto Diagrams are considered to optimize work time. The results show that the productivity of 1 unit of exca CAT 330 increased to 15% with utility reaching 86.89%, i.e., 86,000 tons, and four DT units increasing 40%, with utility equipment reaching 86.52%, i.e.,, 63,741 tons, machine match factor reached 0.61. These results indicate that heavy equipment performance could be improved to achieve the monthly overburden material production target.

For the mining schedule to run smoothly and produce coal immediately, an evaluation of Overburden productivity activities is carried out because there is a report that the production target was not achieved in December 2019, which was 45,000 tons, but the realization only reached 41,740 tons. There are several factors observed by the author so that productivity in overburden excavation is less efficient. Namely, the excavation tool is not optimal yet. The excavation tool is not optimal. There is a narrowing of the hauling to the disposal area at several points, and several other factors are observed more deeply with the quality control circle (QCC) method.

To achieve the Production Target, it can be done by improving the effective time of the Manpower factor so that there is a change in the value of Tool Utility, which increases from 80.66% to 86.89% for CAT 330 digging tool and 79.32% to 86.52%. For DT Hino FM 260 JD transportation equipment, then also hauling road improvements can affect the Tool Cycle Time to increase from 0.48 with a circulation time of 17.27 to 0.61 with a circulation time of 13.41 minutes for DT Hino FM 260 JD resulting in a production value of Exca CAT 330 equipment of 74,114 tons/month to 86,000 tons/month, while for DT Hino FM 260 JD from 41,608 tons/month to 63,741 tons/month. These figures indicasequence's trial for an increase in production targets' achievement to increase by 40% from the actual condition.

Muhsin & Budaya (2019) explains that productive activities are under the predetermined job description, while non-productive activities do not produce added value. These productive and non-productive activities are used for the calculation of workload. The workload can then be used to identify whether the workload received exceeds the maximum limit (more than 100%) or not. When the workload received is more than 100%, it is suggested to add employees.

Based on the workload data, the total overall workload is 1449, with an average of 161 workers assuming the normal conditions of workers, and it should have a value of 100. The excess workload on the Quality Control Department is 1449 - 900 = 549, which means to get the normal workload, it requires 549: 100 = 5.49 or 6 additional workers. Based on the results of data processing, it can be concluded that the workload of employees in the Biology Division Quality Control Department is high at an average of 161%, where the maximum workload limit that should be received is 100%. Therefore, to get a normal workload, six additional workers need to be added. The hiEquation'sd was due to the large number that were not matched by the equivalent number of employees, so every employee also had a full job and many tasks.

Adisuputra (2019) explains companies are not hampered by problems that may arise when implementing quality improvement. It is necessary to have an appropriate and effective quality control system. This can be achieved by carrying out Integrated Quality Control or Total Quality Control. Integrated Quality Control here can be interpreted as a dynamic participatory management system. Its management system involves all employees' active role and leaders from the lowest to the highest to continuously control and improve quality in all fields for customer satisfaction and company progress.

Based on the results of research that has been carried out with the topic Application of Integrated Quality Control to Improve Product Quality, it can be concluded that Integrated Quality Control is an integrated sustainable effort to raise quality

standards from all aspects and has a primary focus on customer satisfaction and the company has implemented integrated quality control to fix various problems that arise around quality, it's just that it hasn't gone well yet. The repairs do not cover all the existing issues, although it has reduced the number of defective products. Defective products experienced a slight decrease in January and February, namely 0.07% and 0.12%. In March, the defective product experienced a very significant decrease of 0.64%. Meanwhile, April, May, and June have almost met its target for the company's defective product limits. A comparison of data from the two semesters shows that the company's quality improvement starting in September gradually until December has reduced defective products for the next period. Roles: pieces that are not aligned with the rotary engine, pieces that are not aligned with the engine, and missing in the printing process. In the analysis process of reducing defective productions within the three major problems, six factors are causing the defections: men, machines, methods, measurements, materials, and environments with men and machines as the biggest contributors. By making continuous improvements, the level of defective production will decrease eventually.

Table 1. Existing literature review of the quality control cycle

No	Paper Identity	Research Object	Result
1	Nasution et al. (2018)	Automotive components	The results after improvement in the handling fixture work elements, sub assy process cycle time decreased from 85 seconds to 70 seconds, the production capacity of the two joint shaft propeller line increased from 96% to 100%
2	Suripatty et al. (2019)	Bottle production	Improvements reduce downtime, namely replacing photosensors with new ones, periodic feeder checks, cleaning alufoil rails, training for filling operators, finding alternative alufoil suppliers and improving the thickness of the wax coating on the alufoil.
3	Dharsono (2017)	Manufacturing industry	Defective sheet/gravel sheet defects 191 times with a value of 19.54 kilos. Other defects There were 49 broken sheets with a value of 3.82 kilos and a Double width of 43 events with a weight of 4.25 kilos
4	Beatrix & Triana (2019)	Shoe Industry Development	Improvements in quality bonding test of 21.15%. Cement stripping on the midsole is the most significant number of the bonding test failure in the Laboratory that is as much as 26.33% from the total collapse of the overall bonding shoes.
5	Aroemsari (2011)	Souvenir Industry	Improvements through the work of a sample of 9000 pieces acquired defects before implemented QCC Circles for 1890 pieces being implemented QCC after a decline of 850 pieces or 55%
6	Maharani (2009)	Health Care organizations	Customer satisfaction, measurable performance, good coordination and continuous improvement
7	Wibowo, Wisnubroto & Parwati (2016).	Manufacturing industry	Through the QCC, the total number of damaged units became 190 units, or the number of damaged products decreased by 34.03%

Table 1. Existing literature review of the quality control cycle (continued)

No	Paper Identity	Research Object	Result
8	Kartika (2017)	Manufacturing Industry	The resulting defect is reduced, reaching 78%.
9	Goyena & Fallis (2019)	Glass Production	The most defective products were spots 42%, scratch 28%, carat 23%, and intersection 7%. With causal factors are factors of workers, production machines, work methods and materials
10	Hernadewita et al. (2019)	Textile Industry	An improvement in the spray gun holder's modification is Abbeku (sticking) loss on the painting production, which is originally 23 lots.
11	Fadly & Yulhendra (2018)	Mining Equipment	The achievement of improvement in loading equipment production increased by around 22.2% and transportation equipment by 28.0%.
12	Riadi & Haryadi (2020)	Automotive Industry	QCC results determine the types of defects that occur frequently and suggestions for improvement.
13	Vanichchinchai & Duantrakoonsil (2018)	PCB Industry	Defective from copper in the hole was reduced significantly from 12.81% to 0.66%.
14	Vanichchinchai (2017)	Productivity Improvement Concept	The paper link the life cycle concept to improvement activity. It can be used as a fundamental study for academia to further research and for practitioners to efficiently and sustainably implement the activity.
15	Tobergte & Curtis (2013)	Automotive Industry	The cause of production defects, the knife used is over cut, the standard of material for the mat, the operator's ability and running the SCW
16	Simanjuntak et al. (2014)	Public Organization	There is a significant relationship between QCC which consists of Participation, Voluntary Activities, Joint Development, and Personal Development with Employee Performance
17	Prasetiyo & Tauhid (2019)	Manufacturing Industry	There was a decrease of 88.3% from D2 defects (Tangled) in Home Furnishing products.
18	Rahmayani & Haryanto (2020)	Shoe Industry	Application development can display the percentage results and an accurate BA rating, present more structured data and create reports more efficiently
19	Suhaimi & Salleh (2018)	Cutting Tools Industry	Productivity and efficiency of the line recorded an increment up to 9.73% and 89.94%, respectively
20	Henny et al. (2019)	Textile Industry	The most dominant type of defect is the inappropriate thread strength, which is 88% for carded yarn and 89% for combed yarn

Table 1. Existing literature review of the quality control cycle (continued)

No	Paper Identity	Research Object	Result
21	Adisuputra (2019)	Raw Materials	Integrated Quality Control is needed to improve quality standards from all aspects continuously.
22	Muhsin & Budaya (2019)	Medicine Manufacturing	Nine workers have a high workload of 161%. The proposed improvement given to overcome this high workload is to add six workers
23	Sumarta & Anaperta (2019)	Mining Industry	There is a potential for an increase in the achievement of production targets, which can increase by 40% from the actual condition
24	Hipni et al. (2019)	Manufacturing Industry	The average percentage of sales revenue increased from 76% to 93%
25	Kartika & Junaedi (2019)	Herbal Medicine	Efficiency results are to reduce microbial contamination to increase product expiration, improve the safety of workers, save costs
26	Supriatin (2018)	Employee Performance	QCC and Work Culture have a significant effect on employee performance.
27	Bachtiar, Parwati, & Susetyo, (2013)	Leather Industry	There are savings in box packing, the need for manpower, reduced idle time, and the cost of storing parts.
28	Syobir & Aulawi (2016)	Rubber Material Industry	The highest defect in the rubber factor is too mature and not paired is the main factor causing rejection
29	Insani (2016)	Hotel Services	Test sig. (0.637)> α (0.05) and the value of t count (0.475) <t table (2.0280). Ho was accepted, and Ha was rejected. There was no significant difference in the performance of hotel employees after implementing the QCC training program.
30	Utama et al. (2020)	Candy Manufacture	A decrease in the percentage of production defects that exist in the company by 0,4%

QCC is a support to achieve this product quality produced by a company. Production and QC must work together. The production makes a good product without any defects, while QC ensures and produces good quality products that are acceptable to customers (Rahmayani & Haryanto, 2020). The quality improvement carried out by business organizations is now being adopted by public organizations. This is under the para-stigma of public organizations, namely New public management (NPM). New public management uses market mechanisms and public sector terminology, which is carrying out the relationships between society and public organizations is the same as transactions carried out by the market world (market-based). In modern management, there are several ways to improve employee performance, one of which is the Quality Control Circle concept in public organizations (Simanjuntak, 2014).

The implementation of QCC showed a significant relationship between quality control consisting of Participation, Voluntary, Joint Development, and Personal Development as independent variables and employee work performance as a dependent variable. These results are shown from the results of the chi-square test, in which all independent variables have a value greater than a significance value smaller than α = 5%. The method of QCC used a tool called the seven tools. We propose an improvement plan within a matrix plan to improvements through the brainstorming process. Riyanto (2015) found that the biggest CTQ

(Critical To Quality) is the flaw leaked. Then we search for the root cause of the problem through a process of brainstorming between QCC teams and the company's management. We found that the most dominant cause of the defect is the machine's low reliability, the lack of rigor operator, and low-quality material. In the Pareto diagram, it appears that the largest percentage of leak defect, approximately 45.9 %. The improvement is only performed on the LT machine (machine of a tester of leakage). After repairing the LT machine, the percentage of defects leaked down from 1.86 % to 1.09 %. So there is a decrease of 0.77 % defect rate.

There are five defects in the manufacture of U-8 blower blades, which are hollow defects, rough surfaces, cracks, widespread roughness, and deformation. Sofiyanurriyanti (Sofiyanurriyanti, 2019) analyzes defects experienced by 1204 products or 20.27% of total production. The rough surface is a type of defect with the biggest disability rate of 53.08% of the total disability of 627 products. To reduce the defects of the U-8, blower products should be focused on the types of rough surface defects. To reduce the type of disability, the operator must be more careful in examining the sand mold, the aluminum raw material must also be clean, and part of the ingot material (bar), the mixture of printed and must be considered, the environmental conditions must apply 5P and add work facilities (lighting) replacement tools such as mold and the addition of temperature drier to the melting furnace.Prasetiyo & Tauhid (2019) said the QCC method is a method that can be used to control product quality and reduce the number of defective products. The results of this study are that Kaizen's work culture has not been effective even though the impact on employee productivity and performance is very influential. From the results of this QCC, it is evident that changes in the new Standard Operating Procedures can reduce the percentage of total defective goods compared to the previous period.

Based on the chart's identification, the influence of QCDSMP (Quality, Cost, Delivery / Delay, Safety, Morality, and Productivity) is a factor of the problems in Department D, the most prominent and not achieving the target is the Quality Graph. QCC Group agrees that this activity is carried out to improve quality. After doing countermeasures, an evaluation is conducted every period before implementing the QCC and after implementing the QCC. The evaluation results from before QCC to after QCC was the handling of D2 defects (Tangles) in NL Home Furnishing design product, indicating a decrease of 88.3%, taken from the field results. This means that the QCC group has succeeded in reducing D2. (Tangle) defects in NL Design Home Furnishing products.

Vanichchinchai & Duantrakoonsil (2018) aims to reduce defects from copper in a drilled hole in PCB with employee participation through quality control circle (QCC) activity and the use of simple quality improvement tools. In Thailand, Vanichchinchai (2013) successfully applied QCC and basic quality improvement tools with employee involvement to increase the world's biggest canned tuna manufacturer's raw material yield. Zheng et al. (2013) studied the cutting mechanism of drilling PCB and decreased burr size. As a result, they found that the burr is mainly caused by burr bending, and the generation of the exit burr is more complicated. This research applied contemporary QCC methodology and had the researchers as consultants. Conceptually, QCC empowers shop floor operators for group association to identify problems in their working area and its root causes to resolve such problems (Olberding, 1998). QCC methodology follows Plan-Do-Check-Act (PDCA) continuous improvement cycle (Salaheldin and Zain 2007; Bushell, 1992). Simple but powerful quality improvement tools and techniques were applied in this action research for employee involvement. Having implemented the improvement above measures, the average three-month defectives from copper in the hole had been significantly reduced from 12.81% to 0.66% (94.8% decrease). These results confirmed that QCC with simple tools could improve the quality of products and the people.

Riadi & Haryadi (2020) explains that methods used to control product quality and reduce the number of defective products are using the Quality Control Circle (QCC) method because the QCC focuses more on improving, suppressing errors, and minimizing defective products. This study aims to reduce the number of defects in fabric material for car seats that are produced directly by the company with a large number of defects and

cut the fabric pattern for the chair. Hernadewita et al. (2019) explain that the QCC method was implemented to improve the production capacity and increase the Enameling line's quality, such as in processes stripes, bubbles, sticks, light colors, etc. By implementing QCC, it's expected that the quality of the Enameling line will increase. This study focuses on implementing the Quality Control Circle method in improving the quality of Enameling production at PT. QWE. The method will be applied to solve the quality problems that occur in high repainting and loss on the enameling line and high complaints related to production quality.

From the analysis using the QCC, to increase productivity by eliminating loss of sticking with the spray gun; this was summarized as follows how to eliminate Abbeku (Sticky) loss? The problem of positioning the spray gun painting machine is to use eight QCC steps and some of the seven tools including tools, fishbone diagrams, and Pareto diagrams, to find the dominant problem to be overcome, production agar painting can be reduced by using tools, fishbone diagrams, and Pareto diagrams. It was finally found that the cause of the high loss of painting production, the most dominant was from machine factors, namely, a spray gun position. Ways to reduce loss in the painting process by improving the spray gun position that can be regulated by the operator to be a spray gun position that fixes and passes with the workpiece that will be in the painting process. To find out the dominant cause of spray gun position and overcome the need for careful analysis of existing conditions using tools QCC and involving the process painting operator.

Kartika (2017) explains that activities in QCC are part of TQM, which aims to develop members' abilities and create a better work environment so that members can participate in achieving organizational goals and provide job satisfaction for consumers. This research is the plastic noodle packaging printing machine, while the object of this research is to improve and minimize problems in the noodle packaging printing process. From the evaluation results and improvement with the QCC approach, it can be seen that by making improvements, the resulting defects are reduced and even exceeded the previous target. Initially, it only targeted 70% but got the result to be 78%, above the previous target.

Bachtiar, Parwati & Susetyo (2013) explain that the work is done manually, allowing the product to damage from a mold that is not according to standard due to frequent wear and reduced worker work concentration. Hence, there needs to be an improvement. The study analyzed the number of defective products and made improvements by collecting data on the check sheet, creating a histogram, scatter diagram, control chart, Pareto diagram, and fishbone diagram. And analyzed with Seven Tools, continued to perform Quality Control Circle. Based on research which has been done obtained results, Quality Control Circle concept conduct meetings for eight times with activity schedule week 1 find a problem and result from a theme from meeting defect type constitute the most defect type, then searching for causes problems. The selected problem is decreased defect type, and next determine to cause the most dominant. Week 2 find countermeasures, next week 3 did countermeasures, and week four did evaluation after Quality Control Circle total defect become 105 unit from 121 unit. Total all defects before the Quality Control Circle 288 unit after improved use Quality Control Circle total defect became 190 unit or total defect product has decreased 34,03%.

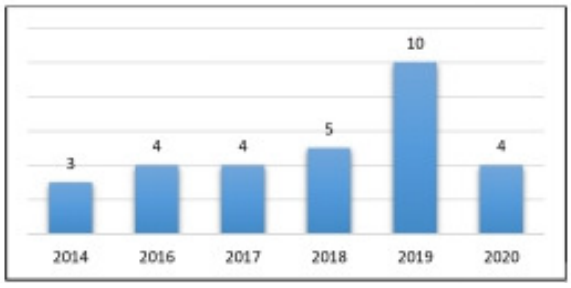

Fig. 2. Journals distribution over the years

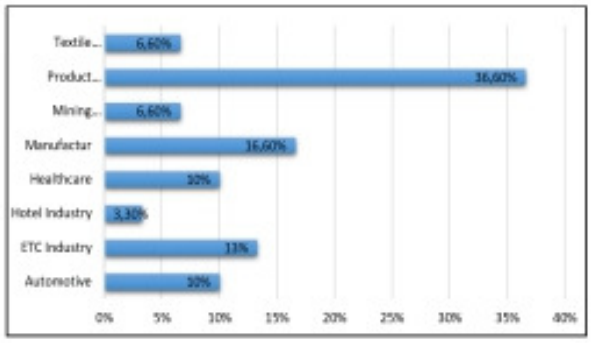

Fig. 3. Journals distribution in 30 papers sample

First, an overview of the field is presented, positi-oning the topic within the context, and provide results. The convergence of sustainable QCC is a

topic that has evolved in recent years, and papers' distribution indicates an evolutionary trend compatible with a new research field. Fig. 2 on the distribution of papers and journals can be seen by each sector using quality control circle widely used in the industrial and manufacturing sectors. It aims to reduce defective products and improve quality and productivity. All citations in the sample were listed, totalizing 30 references, allowing to identify the most cited journals, listed in Table 1. As identified, the scope and disciplines concerned with sustainable manufacturing are service industries, and the same trend is being applied in the context of the quality control circle (Fig. 2)

3.1. Gaps and relations between QCC and industry 4.0 for future research

With the introduction of the Internet of Things (IoT) concepts in industrial application scenarios, industrial automation is undergoing a tremendous change. This is made possible in part by recent advances in technology that allow interconnection on a wider and more fine-grained scale. The industrial world's ability to increase production capacity and maintain quality indirectly has a major role in society, especially regarding socio-economic problems such as layoffs, poverty, etc. (Fig. 4).

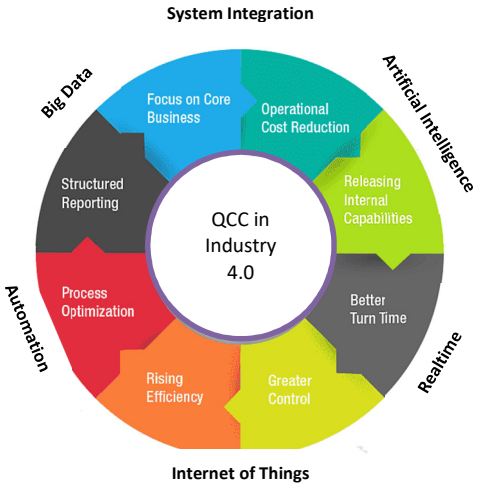

Fig. 4. Future research framework

The industry can contribute to the country's foreign exchange because it can create jobs, increase national products, exports, etc. For industrial development in the current era, it is necessary to provide equipment/technology support; this is because the use of technology will determine the quantity and quality of production results so that the output produced meets the criteria as expected by consumers and also in facing the challenges of the industrial revolution 4.0. To face the challenges of the industrial 4.0 perspective to improve quality and production, each company must facilitate equipment assistance; increase access and market share; promote innovation, and provide QCC training.

4. CONCLUSION

This paper reviewed 30 articles, founded most quality control circles members to achieve individual goals and group learning, and received an invisible benefit from enriching the social relationship, such as concerning team members outside of the workplace and increasing group centripetal force. In this review, the authors had not had the chance to interview the QCC members personally or join their QCC activities; therefore, for future study.

Based on the conclusions, we can believe that organizational learning in any industry's research field has many potential opportunities. First, in clinical and managerial practice, QCC and TQM can help employees reinforce their working ability, skill, and knowledge. This can help group members become the automatic learner. Second, the performance research perspective might help organizations develop an appraisal system, but individual and group learning are also important to organizations. Third, through quality control circles activities, most of the employees could learn and inspire the new idea of quality themes, and it was an important competence for organizations. This review paper reviewed literature through cross-section research. It is hoped that this paper will encourage future empirical work in examining quality control circles, and other quality improvement and control activities could use the different perspectives of depth analysis.

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