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THE APPLICATION OF USING STATISTICAL PROCESS CONTROL (SPC) METHOD: LITERATURE REVIEW AND RESEARCH ISSUES

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ABSTRACT

A large company or industry must be able to overcome and resolve any problems that are being faced or in the future. Given that quality is the main thing that will measure the success of a company. One of the methods used in quality control is Statistical Process Control (SPC). The method to be used for this study is the study of literature. The method used is to review the 2016-2020 research papers that consistently apply the SPC method and have been published. The literature review process in this study combines published and relevant literature meta-analyses to provide some evidence of the effect of the existence of the implementation of the SPC method with several classifications. The classification includes the growth of research publications in the manufacturing sector and other sectors. The results of research literature that have been published from 2015 - 2020 is this research is useful as a basis for developing knowledge, gaps in views, providing evidence of effects, and if done well, has the capacity to be applied as further research ideas. An objective application of the SPC method can result in the elimination of waste as reduce defect and increasing quality and improving process. Subjective application of the SPC method requires high process commitment because the SPC method implements must be carried out continuously.

INTRODUCTION

A large company or industry must be able to overcome and resolve any problems that are being faced or in the future. This is one of the efforts or efforts to maintain the company. This is where the role of quality management is needed. Given that quality is the main thing that will measure the success of a company. One of the methods used in quality control is Statistical Process Control (SPC). The concepts of Statistical Process Control (SPC) were initially developed by Dr. Walter Shewhart of Bell Laboratories in the 1920's, and were expanded upon by Dr. W. Edwards Deming, who introduced SPC to Japanese industry after WWII (Giovannini & Nezu, 2001). After early successful adoption by Japanese firms, Statistical Process C ontrol

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has now been incorporated by organizations around the world as a primary tool to improve product quality by reducing process variation.

Dr. Shewhart identified two sources of process variation: Chance variation that is inherent in process, and stable over time, and Assignable, or Uncontrolled variation, which is unstable over time - the result of specific events outside the system. Dr. Deming relabeled chance variation as Common Cause variation, and assignable variation as Special Cause variation. Based on experience with many types of process data, and supported by the laws of statistics and probability, Dr. Shewhart devised control charts used to plot data over time and identify both Common Cause variation and Special Cause variation.

A control plan should be maintained that contains all pertinent information on each chart that is maintained, including:

a. Chart Type
b. Chart Champion - Person(s) responsible to collect and chart the data
c. Chart Location
d. Measurement Method
e. Measurement System Analysis (Acceptable Error?)
f. Reaction Plan
g. Gauge Number - Tied in with calibration program
h. Sampling Plan
i. Process Stability Status
j. Cp & Cpk

RESEARCH METHOD

The method to be used for this study is the study of literature. The data obtained are compiled, analyzed, and concluded so as to obtain conclusions regarding the study of literature (Tranfield et al., 2003). Research with literature studies is also research and can be categorized as a scientific work because data collection is done by a strategy in the form of a research methodology. An effective and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster & Watson, 2002). The implementation literature review method can compare several journals that use the settlement with SPC method. Comparisons of several journals have been carried out to find common objects, methods, and problem-solving. This can also illustrate the capabilities of the SPC tools. The database is used from google schoolar. In addition, this can highlight the features of the SPC method. The method used is to review the 2016-2020 research papers that consistently apply the SPC method and have been published. Using the 2016-2020 research paper, to find out the development of the SPC method in recent years and also the level of success after applying the SPC method. The first iterations authors used in the searching mechanism, there are one thousand two hundred and seventy articles, then hundred of them were discarded since there are irrelevant with SPC application focus by author criteria. Until just 50 articles included as part of the criteria and research focus. The journals can be classified according to year of published as shown in Figure 1.

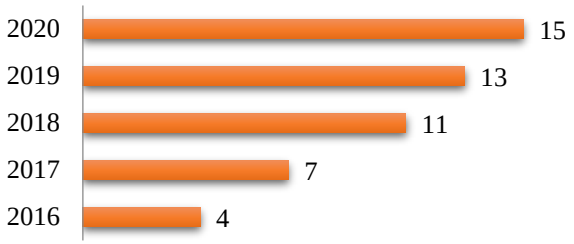

Figure 1. Year of published

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The research method is shown in Figure 2. Within this article, the method contains ten main methods for undertaking a comprehensive analysis of literature.

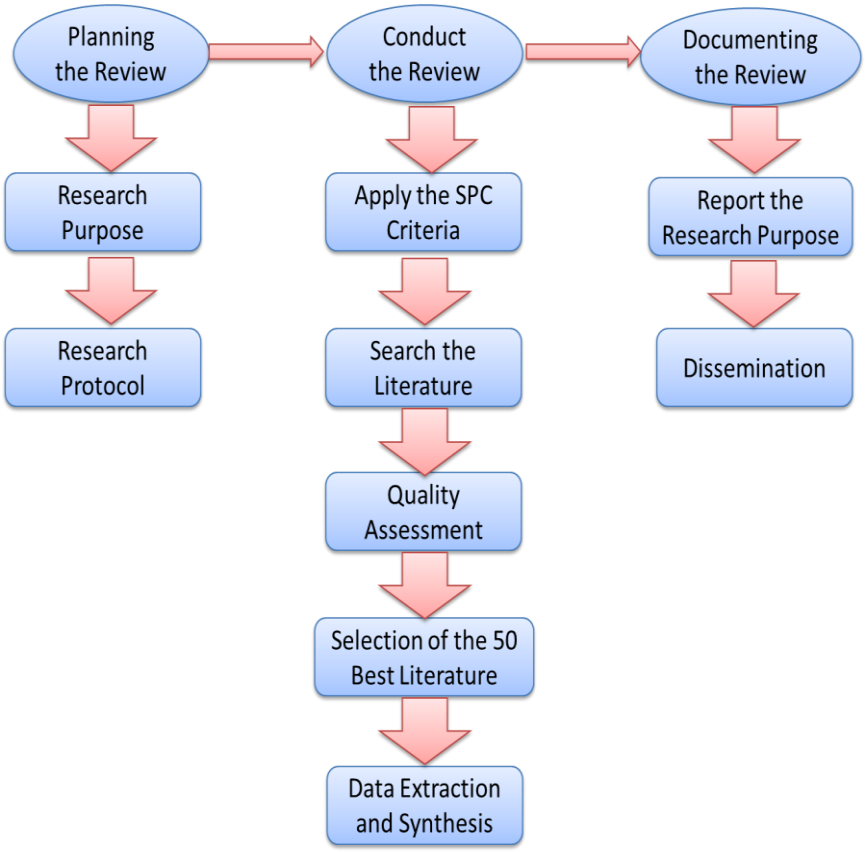

Figure 2. Research framework

The stages carried out in this research were:

1. Purpose and objective of research: the purpose and objectives are clearly identified following a review of the most common gaps in the literature.
2. Establish analysis protocol: the protocol encompasses the nature of the sample, the technique, the requirements, the quality assessment, and the retrieval of data, and so on. This approach should be observed during a thorough analysis of the literature.
3. Create validity standards: review guidelines aim to ensure that only the papers most applicable to the study topic are included and that irrelevant papers are omitted.
4. Search and recover literature: online work for related publications in top scientific and professional papers, and hand analysis in bibliography databases, if applicable.
5. Variety of studies: depending on the test requirements.
6. Quality assessment for specific studies: usage of effective quality evaluation methods. The content of each report will be measured according to the methods used.
7. Information extraction: collect the appropriate details from each of the experiments used in the study.
8. Integration of research (study): the usage of suitable methods, such as quantitative or qualitative analysis, or the variation of the derived data.
9. Reporting: commenting in-depth on the systematic examination of literature as well as the findings of the study.
10. Dissemination: publication of systematic analysis in a scholarly journal to add to the information in the area.

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RESULTS AND DISCUSSION

A literature review is a useful disciplinary activity to provide an overview of a particular problem or research problem by evaluating the state of knowledge about a particular topic. In this case, the literature review was developed by analyzing the research literature published in 2016-2020 relating to the SPC method (Table 1). Under the right conditions, all of these classifications can greatly assist certain research. However, please note that there are many other forms of literature review, and elements of the approach are different or combined. This is because the approach taken is quite extensive, and needs to be further adapted for certain research. In the following, the basic steps and important choices involved in conducting a literature review will be suggested and discussed using four phases; (1) designing reviews, (2) conducting reviews, (3) analyzing and (4) writing reviews. (Tranfield et al., 2003)

Table 1. Existing literature review of SPC

Aspect	Research Object	Name of Researcher	%
Research Approach			
A. Quantitative			
Reduce	- Defect / Reject	(Godina et al., 2016), (Puspitasari, 2017), (Devani & Wahyuni, 2017), (Supriyadi, 2018), (Abtew et al., 2018), (Rusdy & HS, 2018), (Von Benzon Hollesen et al., 2018), (Chaabane et al., 2018), (Wirawati, 2019),(Primasanti & Susilo, 2019), (Fajar Ningrum, 2019), (Hidayat, 2019), (Gil Del Val et al., 2019), (Zgodavova et al., 2020), (Inadomi et al., 2020), (Dimyati et al., 2020), (Elyas & Handayani, 2020), (Ata et al., 2020)	36
	- Cost	(Young & Lebow, 2020)	2
Increase	- Quality	(Khorshidi et al., 2016), (Aini et al., 2017), (Saputra et al., 2019), (Dönmezer, 2019), (Sunadi, Purba, & Saroso, 2020), (Pascu et al., 2020), (Sunadi, Purba, & Hasibuan, 2020), (Rana et al., 2020)	16
	- Profit	(Madanhire & Mbohwa, 2016), (Godina et al., 2018)	4
Improve	- Process	(Abdul Halim Lim et al., 2017), (Egorov et al., 2017), (Solihudin & Kusumah, 2017), (Hrvačić, 2018), (Bahari et al., 2018), (Zasadzień & Midor, 2018), (Rasay et al., 2018), (Saifuddoha & Islam, 2019), (Amin & Venkatesan, 2019), (Chandrabalan et al., 2019), (Jin et al., 2019) (Wahyudin et al., 2019), (Hsu et al., 2020), (Silverstein et al., 2020), (Girma & Sahu, 2020)	30
B. Qualitative			
	- Qualitative Analysis	(Lim & Antony, 2016), (Halim Lim et al., 2017), (He & Wang, 2018), (Wiecha & Ćwikła, 2019), (Naseri et al., 2020), (Prata et al., 2020)	12

This literature review collects quantitative and qualitative research. In several papers using primary data and secondary data. Background papers made as a literature review are mostly from the industrial sector. In addition, most of the benefits of implementing the SPC method are aimed at reducing defects and improving process. The literature review process in this study combines published and relevant literature meta-analyses to provide some evidence of

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the effect of the existence of the implementation of the SPC method with several classifications. The classification includes the growth of research publications in the manufacturing sector and other sectors.

A. Growth of SPC publications in the manufacturing sector

SPC is usually applied in the manufacturing sector, following some research that is applied in the manufacturing sector. The SPC approach can also be used to reduce the defect and cost or improve process at production floor. Based on table 1, it can be explained that there are 18 journals that use SPC as a method of reducing defects in the manufacturing sector. In addition, there are 15 journals that focus on improving processes in the manufacturing sector. One special journal to reduce costs using the SPC tool. Usually, the SPC tool is also used to improve quality as in the 6 journals in table 1.

B. Growth of SPC publications at another sector

SPC tool can also be used outside in the manufacturing sector. Based on Table 1, it can be explained that there are 2 journals that use SPC as a method of increase quality at another sector. In addition, the SPC tool can be used to increase profits other than in the another sector as in the 2 journals in table 1. Meanwhile, 6 other qualitative journals discussed the use of SPC tools other than in the manufacturing sector.

Based on the paper reviewed, the benefits of successful implementation of the SPC tool in the manufacturing or another sector from the most journals to the fewest as shown in Figure 3 are:

1. Reduce Defect
2. Improve Process
3. Increase Quality
4. Qualitative Analysis
5. Increase Profit
6. Reduce Cost

In applying the PDCA method, commitment is needed because the PDCA method implements a cycle process which means Plan, Do, Check, and Action must be carried out continuously. 10 classifications have been explained which are the dimensions of the research variable as shown in Figure 3 explains the small scope of the research variable. The result of the research variable can be assumed that the lack of trends in the manufacturing sector has resulted in a real calculation of the success rate of using the SPC tool. More researchers use the SPC tool for qualitative research. While qualitative research is less able to show the success rate of implementation of the SPC tool applied. There is a need for further research to update the method used to be able to demonstrate the degree of success of its implementation.

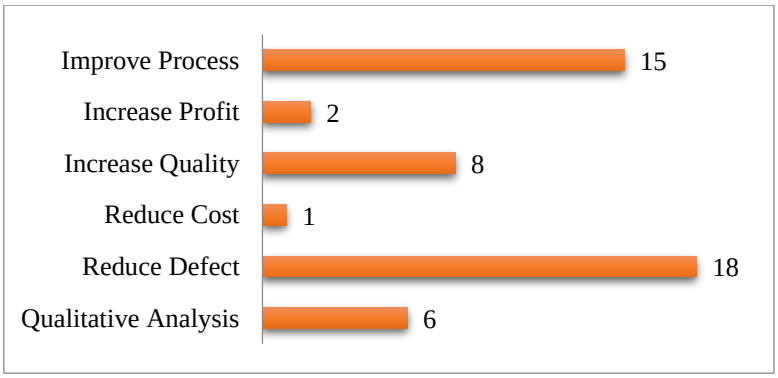

Figure 3. Dimensions of the research variable

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CONCLUSIONS

There is an essential role in research by conducting literature reviews such as in the " The Application of Using Statistical Process Control (SPC) Method: Literature Review and Research Issues" from the results of research literature that have been published from 2015 - 2020 is this research is useful as a basis for developing knowledge, gaps in views, providing evidence of effects, and if done well, has the capacity to be applied as further research ideas. An objective application of the SPC method can result in the elimination of waste as reduce defect and increasing quality and improving process. Subjective application of the SPC method requires high process commitment because the SPC method implements must be carried out continuously.

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