International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

Effective Implementation of CSFs in SPC Using Pareto Analysis Approach

R. V. Patil[1], Shyamal Dey[2], Rajeev Ranjan[3]

[1]Research Scholar, Mechanical Engineering Department, Oriental university, Indore

[2]Professor and Head Mechanical Engineering Department, Oriental university, Indore

[3]Assistant Professor. Mechanical Engineering Department. Oriental university, Indore

Abstract: ***Statistical process control (SPC) is an integral part of statistical quality control (SQC) tools. SQC tools are used for finding out the deviations and defects of finished components. Critical success factors (CSFs) provides information regarding decisions in the success of processes, to improve the performance and to maintain the control of processes at top quality levels. Determination of CSFs of SPC implementation mostly were done in empirical approach. From an extensive review of literature of statistical process control implementation, forty three dimensions of statistical process control critical success factors were identified. Statistical analysis of questionnaire responses on the success factors resulted into two distinct sets of critical and useful other factors. This study is motivated to compile and sort the 19 vital CSFs and 24 useful other CSFs from forty three dimensions of statistical process control CSFs by using Pareto analysis approach. This approach shows that top level management involvement and their commitment is most important factor for implementation of SPC at any industry.***

Keywords: Total Quality Management (TQM), Critical Success Factors (CSFs), Statistical Process control (SPC), Critical to Quality

1. Introduction

Six Sigma, Lean Sigma and Total Quality Management are the current improvement methodologies many manufacturing companies and organizations are embarking on to improve productivity and quality for corporate survival. To be successful in promoting business effectiveness and efficiency, TQM must be truly organization-wide; it must start at the top with the chief executive or equivalent [4]. Oakland [5] view on leadership by stating, the chief executive of an organization should accept the responsibility for and commitment to a quality policy in which he/she must really believe. If the owners or directors of the organization do not recognize and accept their responsibilities for the initiation and operation of TQM, then these changes will not happen. One of the technique that is being applied for improvement in quality is Statistical Process Control (SPC) [6].Quality plays an important role in every manufacturing and service organization. In order to achieve quality, every stakeholder involvement and commitment strategy requires known as Total Quality Management (TQM) [10]. SPC is a part of TQM and statistical-based structured program mostly used for monitoring, controlling, analyzing, managing and improving a process facilitated by problem solving and quality tools. SPC is considered a building block for quality management systems such as total quality management (TQM), ISO 9000, six sigma, and for other various control techniques. CSFs set in each study have subsequently caused confusion for researchers and industry to incorporate the CSFs in the SPC implementation phase [14]. In developing a sound instrument for CSFs, hypothesis testing is extremely tedious and demands meticulous work. It is crucially important for researchers to identify the vital CSFs to be included in their CSFs studies. From previous literature reviews, it can be viewed that there were still lack of a documented CSFs using statistical approach. This paper offers a compilation of the CSFs reported by the scale development studies and other relating literature of effective SPC implementation. Furthermore, from the compilation of CSFs, this study will categorize and report a set of vital CSFs based on the frequency of occurrences in past SPC literature. Articles contain technical aspect of SPC implementation without management or human aspects are excluded. However, CSFs can still be accepted if the articles highly recommend the factors for effective SPC implementation. Factors extracted from the articles were recorded in a table at no specific order. Then the definition of the factors were compared and contrasted. The CSFs categorization was done through a judgmental process for grouping the factors with a similar description. Data collected from the statistical analysis of questionnaire responses on the success factors were listed and the records the frequency of each classification under each factors label. The Pareto analysis was done to identify the most important CSFs for SPC implementation. This paper presents the results of a Pareto analysis with regards to successive factors for effective implementation of SPC.

2. Literature Review

Based on literature, ‘Success factors’ was popularized by J. Rockart in 1979 using the critical success factors (CSFs) process for information system design. This study emphasized that searching for CSFs is an activity that should receive continuous attention from management. Hence, in order to maximize the benefits of SPC implementation, the system is applied by decision managers who understand crucial factors for SPC implementation success. Jafri Mohd Rohani et al, 2010 highlights the instrument development to measure the relationship between statistical process control success factors construct and performance construct. Connie Rokke and Om Prakash Yadav, 2012 explored the history of

TQM philosophy and the challenges to effective implementation of TQM in the industries. J.R. Evens et al, M.E. Gordon et al and J. Rockart presents articles of SPC implementation including the use of empirical study approach. M.Xie and T.Goh presented a summary of practical and managerial issues in statistical techniques especially the role of SPC in process improvement. A survey research was carried out using the term CSFs determination for SPC implementation with the purpose of ranking 12 CSFs in SPC implementation [11]. Organizations always begin with a starting point of a 'best practice' for SPC implementation and deployment [13]. In this study, from an extensive review of literature of statistical process control implementation, forty three dimensions of statistical process control success factors were identified.

3. Pareto Analysis

Practically, Pareto analysis is a common quality tool utilized in marketing, quality control management and manufacturing discrepancy. Pareto analysis works by ranking the data classification in a descending manner from the highest to lowest frequency of occurrence. The Pareto 80/20 principle is validated on many practical examples in which 80 percent of the problems originates from 20 percent of the possible causes. Therefore, the value of the Pareto principle is that focus should be given first to the critical factors constitute in the 20 percent. The analysis has suggested the most important 20 percentage vital CSFs constitute 80 percentage of occurrences

3.1 Figures

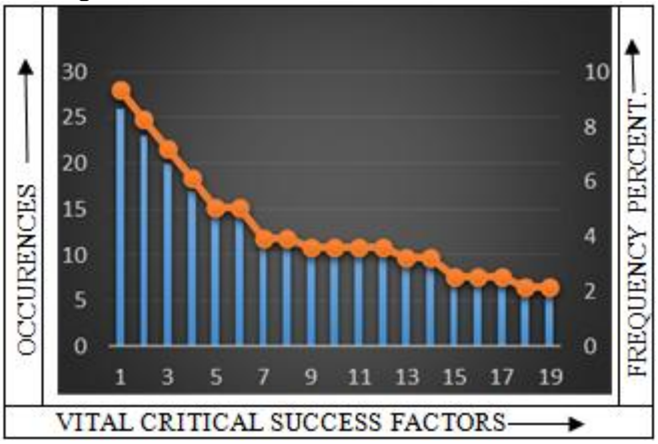

Figure 1: SPC Critical Success Factors

3.2 Tables

Table 1: Vital critical success factors

Sr. no.	*Critical success factors*	*Occurrences*	*Frequency Percentage*	*Cumulative percentage*
1	**Top Management**: top management commitment, management responsibility, management action	26	9.35	9.35
2	**Training:** top management training, information ,knowledge and education of SPC	23	8.27	17.63
3	**Process capability and measurement system analysis:** process capability analysis, verification and evaluation of measurement system, measurement framework, quality measurement	20	7.19	24.82
4	**Control chart application:** Assignable cause identification, control chart selection, design and construction, control chart analysis	17	6.12	30.94
5	**Team work and SPC implementation team:** Quality improvement and SPC implementation team	14	5.04	35.97
6	**Cultural change:** Resistance to cultural change, ability to change	14	5.04	41.01
7	**Identification of process/ product characteristics**: critical parameters, key process/ product parameters, critical to quality characteristics	11	3.96	44.96
8	**Technology**: integrated quality information system, SPC software and its packages	11	3.96	48.92
9	**Process prioritization**: Process prioritization	10	3.60	52.52
10	**Pilot study**: Pilot study, pilot project	10	3.60	56.12
11	**Data requirement**: Data quality, Data collection procedure, sampling scheme,	10	3.60	59.71
12	**Feedback and responsiveness:** control plan, corrective action	10	3.60	63.31
13	**Continuous improvement:** continuous improvement approach/ philosophy	9	3.24	66.55
14	**Process description**: Process definition, evaluation, analysis	9	3.24	69.78
15	**Process planning:** Strategic planning, strategic quality management design, SPC plan, planning	7	2.52	72.30

16	**Documentation:** SPC reports, documentation update knowledge, process maintenance and documentation, reporting, recording of each step	7	2.52	74.82
17	**SPC facilitators:** SPC facilitators	7	2.52	77.34
18	**Customer satisfaction orientation**: customer satisfaction, customer focus, customer requirement	6	2.16	79.50
19	**Employee empowerment**: user centered, people empowerment, employee involvement, worker visibility	6	2.16	81.65

Table 2: Useful other factors

Sr.no.	*Useful other factors*	*Frequency of occurrences*	*Frequency Percentage*	*Cumulative percentage*
1	Identification of key areas	4	1.80	1.80
2	Communication	5	1.80	3.60
3	Quality department	3	1.08	4.68
4	Vision and mission	3	1.08	5.78
5	Process focus	3	1.08	6.83
6	Techniques	3	1.08	7.91
7	Human resources management	3	1.08	8.99
8	Integrated quality information system	3	1.08	10.07
9	Quality system	2	0.72	10.79
10	Statistical support	2	0.72	11.51
11	Iterative development of the system	2	0.72	12.23
12	Social responsibility	2	0.72	12.95
13	Statistical and engineering skill	2	0.72	13.67
14	Material quality	2	0.72	14.39
15	Supplier management	2	0.72	15.11
16	Leader selection	1	0.36	15.47
17	Middle management	1	0.36	15.83
18	Benchmarking	1	0.36	16.19
19	Information and analysis	1	0.36	16.55
20	Final inspection	1	0.36	16.91
21	Reward and recognition	1	0.36	17.27
22	Self-assessment	1	0.36	17.63
23	Awareness	1	0.36	17.99
24	Knowledge	1	0.36	18.35

4. Result and Discussion

A total number of 43 CSFs were identified and grouped from reviewed studies. The frequency of factors affecting effective SPC implementation was compiled with the total of 278 occurrences. Results of the analysis are presented in Table1 Based on the Pareto analysis in Table1 and Figure 1, although there 43 CSFs identified, however 19 of the CSFs classified in 'vital few' group which affected 80 percent of the SPC implementation effectiveness/success. The remaining 24 useful other factors made up only 20 per cent of occurring frequencies associated with SPC implementation success and were listed under the 'useful other' section. The top CFSs in 'vital' are 'top management commitment' with a total of 26 occurrences, followed by training with 23 occurrences and process and measurement system capability analysis with 20 occurrences.

Top management is the most prevalent factor associated with the success not just for SPC implementation system, but for any quality management system. Top management commitment is a latent variable, which cannot be measured directly. In committing to quality, top management has to make a sufficient effort and provide adequate resources. Hence, adequate resources provision, emotional support, program involvement and project approval can be provided in a manifestation of top management to quality. For new introduction of new technology, training is a compulsory step for better execution of the technology. Training of SPC should exposed relevant statistical knowledge, quality tools along with the interpretation ability and the appreciation of applying SPC. A measurement system has a great deal of variation which sourced from the operator (skills and experiences), gauges and the part being measured and process capability is a critical to quality with a specified time. In this matter gauge capability analysis is useful to measure measurement system variability. Accuracy of the measurement is essential to minimize potential errors of data. SPC implementation may only effective if the process and measurement system is capable.

Although the rest of 24 factors (Table 2) fall under 'useful other' group, however, it does not imply these factors should be excluded from SPC implementation components, but instead should still be used for effective SPC implementation after the vital few CSFs have successfully been placed in SPC implementation

5. Conclusion

The results of this study show that identification of a crucial few factors has enlightened academic researchers and especially industries, for selecting the most critical CSFs due to the difficulties of using a large number of CSFs. The result shows there are 19 vital CSFs with top management has topped the list. Therefore, organizations enable to make a selection of the most critical CSFs in this study and using it in their SPC implementation project. This study has limitation in which it only provided a standardized set of CSFs without consider specific industry. A study in design of management control system need to examine CSFs in a specific industry with the argument that the companies in certain industries will operate with specific strategies and needs. Researchers may do study in determining CSFs for SPC implementation in specific industry will be provide interesting results to be compared with the sets of standard CSFs.

References

[1] Fabiano Rodrigues Soriano, Pedro Carlos Oprime, Fabiane Letícia Lizarelli, "Impact analysis of critical success factors on the benefits from statistical process control implementation," Production, vol. 27, no.8, pp. 1-13, 2017

[2] Sarina Abdul Halim Lim and Jiju Antony, "The Implementation of Statistical Process Control in the Food Industry: A Systematic Review," Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management Bali, Indonesia, 1683-1691, January 7 – 9; 2014.

[3] Evans J. R, R. Mahanti, "Critical Success Factors for Implementing Statistical Process Control in the Software Industry," Benchmarking: An International Journal, vol. 19, issue 3, pp. 374–394, 2012.

[4] Connie Rokke and Om Prakash Yadav, "Challenges and Barriers to Total Quality Management: An Overview," International Journal of Performability Engineering, vol. 8 no.6, pp. 653-665, November 2012.

[5] Oakland, J, "Leadership and Policy Deployment: The Backbone of TQM," Total Quality Management & Business Excellence, vol.22 issue 5, pp. 517-534, 2011.

[6] Jafri Mohd Rohani, Shari Mohd. Yusof and Ismail Mohamad, "The development of a survey instrument for measuring a relationship between statistical process control success factors and performance," Journal Mekanikal, vol.30, pp. 1-16, June 2010.

[7] Noskievicová J.D, Effective implementation of SPC. Engineering the Future, 1st ed. L. Dudas, Ed. Rijeka: Sclyo, pp.217–240, 2010.

[8] Rohani J.M, S. M. Yusof, "Statistical Process Control Success Factors and Performance: An Exploratory Analysis," Advances in Quality Engineering and Management Research University Teknologi Malaysia, 2009.

[9] Nizam J Mohd Ab Rahman, Rosmaizura Mohd Zain, Zulkifli Mohd Nopiah, Jaharah A Ghani, "The Implementation of SPC in Malaysian Manufacturing Companies," European Journal of Scientific Research; vol. 26, no.3, pp. 453-464, ISSN 1450-216X; 2009

[10] Antony J, T. Taner, "A Conceptual Framework for the Effective Implementation of Statistical Process Control," Business Process Management Journal, vol. 9, no. 4, pp. 473–489,2003.

[11] Rungasamy J.S, J. Antony, S. Ghosh, "Critical Success Factors for SPC Implementation in UK Small and Medium Enterprises: Some Key Findings from a Survey," The TQM Magazine, vol. 14, no. 4, pp. 217–224, 2002.

[12] M. Xie, T. Goh, "Statistical Techniques for Quality," The TQM magazine, vol. 11, Issue No. 4, pp. 238–242, 1999.

[13] Schippers W.A.J, "Applicability of Statistical Process Control Techniques," International Journal of Production Economics, pp.56-57: 525–535, 1998.

[14] Doe R.J.M.M, W.A.J. Schippers, A. Trip, "A framework for implementation of statistical process control. International Journal of Quality Science," vol. 2, issue 3, pp. 181-198. *MCB University Press:* 1359-8538, 1997.

[15] Gordon M.E., J. W. Philpot, G. M. Bounds, W. S. Long. "Factors Associated with the Success of The Implementation of Statistical Process Control," The Journal of High Technology Management Research, vol.1, pp. 101–121, 1994.

[16] Owen M, B. Dale, P. Shaw, "Implementing SPC: Keys to success," The TQM Magazine, vol.1, no.5, pp.279–283, 1989.

[17] Rockart J, "Chief Executives Define Their Own Data Needs," Harvard Business Review, 1979.