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A Pareto-Analytic Approach to CSF Application in SPC

Induru Yamini

India

Abstract: Tools for statistical quality control (SQC) include statistical process control (SPC). Finding the variations and flaws in completed components is the job of SQC tools. To increase performance and keep process control at top quality levels, critical success factors (CSFs) provide information on choices in process success. For the most part, empirical methods were used to determine the CSFs of SPC deployment. Critical success indicators for statistical process control throughout 43 dimensions were determined after a thorough literature study on the topic. Based on the statistical analysis of the success factor questionnaire answers, two separate groups of important and helpful additional variables emerged. The purpose of this research is to apply a Pareto analysis technique to collect and organize the 19 most important CSFs and 24 additional CSFs from 43 different statistical process control CSF dimensions. According to this method, the most critical component of implementing SPC in any business is the active participation and dedication of upper-level management.

Keywords: The acronyms TQM, CSF, SPC, and CQ stand for "critical to quality" and "total quality management."

1. Introduction

A lot of industrial businesses and organizations are now using improvement approaches like Six Sigma, Lean Sigma, and Total Quality Management to boost productivity and quality. If Total Quality Management (TQM) is to be effective in boosting company efficiency and effectiveness, it must permeate the whole firm, beginning with the CEO or someone with similar authority [4]. The chief executive officer of a company should take full ownership of the company's quality policy and be fully committed to it, according to the Oakland [5] theory of leadership. These alterations will not materialize until the company's leaders acknowledge and embrace their roles in launching and running TQM. Statistical Process Control (SPC) is one method that is being used to enhance quality [6].Any business that provides a product or service relies on quality. Total Quality Management (TQM) is an approach that needs all stakeholders to be involved and committed for quality to be achieved [10]. With the use of problem-solving and quality-tools, SPC—a component of TQM—is a statistically-based structured program that is primarily employed for the purposes of monitoring, controlling, analyzing, managing, and improving a process. Statistical process control (SPC) is an essential component of quality management systems like TQM, ISO 9000, six sigma, and others. Researchers and industry have been left confused about how to integrate the CSFs into the SPC implementation phase due to the CSFs specified in each study [14]. Testing hypotheses is a time-consuming and painstaking process that is essential to creating a reliable instrument for CSFs. Finding the most significant CSFs to include in CSF investigations is a top priority for researchers. It is clear from earlier literature assessments that there is still a dearth of reported CSFs that use a statistical methodology. The article

provides a synopsis of the CSFs articulated in research on scale development and related literature on successful SPC implementation. In addition, this research will classify and report on a set of critical CSFs from the CSF collection according to how often they appear in previous SPC literature. This article focuses on the technical components of implementing SPC and does not address the managerial or human factors. Articles that strongly suggest the elements for efficient SPC implementation may nevertheless have CSFs recognized. There was no particular sequence in which the factors retrieved from the articles were entered into a table. Next, we examined and contrasted the factor definitions. In order to classify the CSFs, a judging procedure was used to group components that had comparable descriptions. Here you may

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see the data that was derived from the statistical analysis of the success factors questionnaire. The records show how often each categorization was used for each factor. The most critical success factors (CSFs)

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.

2. 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

2.1 Figures

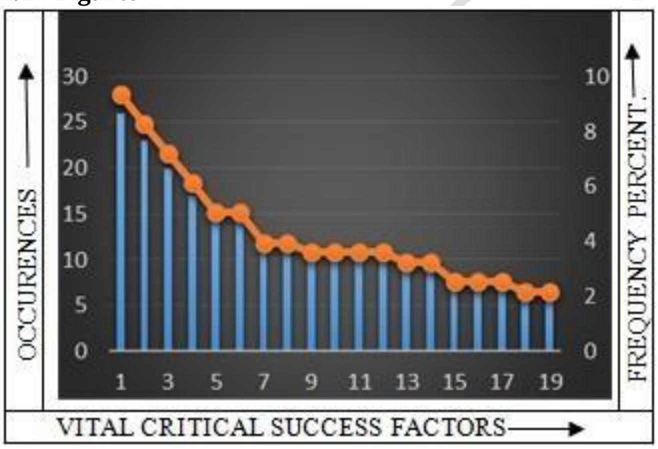

Figure 1: SPC Critical Success Factors

2.2 Tables

Table 1: Vital critical success factors

Sr. no.	*Critical success factors*	*Occurrences*	*Frequency Percentage*	*Cumulative percentage*
	and education of SPC			
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

1	**Top Management**: top management commitment, management responsibility, management action	26	9.35	9.35
2	**Training:** top management training, information ,knowledge	23	8.27	17.63

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

3. 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

4. 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.

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