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Comparing Functions, Costs, and Rewards of Quality Engineers and Six Sigma Black Belts

By C. Grant Short, M. Affan Badar, Christopher J. Kluse, and Marion D. Schafer

ABSTRACT

The respective American Society for Quality (ASQ) Bodies of Knowledge (BoKs) for Certified Quality Engineers (ASQ, 2015a) and Certified Six Sigma Black Belts (ASQ, 2015b) are quite similar; yet anecdotally six sigma black belts are recognized and rewarded more highly than are quality engineers. While quality-engineering work is considered preventive in nature, work performed by six sigma black belts is in the realm of improvement, hence reactive. Thus, a dichotomy exists in that preventive actions, which are less costly, are not rewarded as well as costlier reactive actions. The intent of this research was to confirm or debunk the anecdotal evidence and determine the root causes therefrom. The results confirm the anecdotal evidence and indicate the need for further research. In addition, the results confirm the use of the Kano Model as applicable to the cause for rewarding this dichotomy.

Keywords: *Six Sigma Black Belt, Quality Engineer, Corrective Actions, Preventive Actions, Kano Model*

INTRODUCTION

The era of modern Quality Assurance began with Dr. Walter Shewhart's publication of "Economic Control of Quality of Manufactured Product" in 1931. Most notable are Shewhart's three postulates for the "Scientific Basis for Control":

- **Postulate 1:** Chance systems of cause are not all alike in the sense that they enable us to predict the future in terms of the past,
- **Postulate 2:** Control systems of chance causes do exist in nature, and;
- **Postulate 3:** Assignable causes of variation may be found and eliminated.

In these three postulates rest the concepts, demonstrated by history, of the ability to differentiate and separate common cause variation ("chance systems of cause") from special ("assignable") cause variation, and eliminate the special cause variation, resulting in predictable processes (Shewhart, 1931).

Based on Shewhart's work, Dr. Joseph Juran, one of Shewhart's protégés at Western Electric, delved deeper into quality assurance philosophy and developed and published what has become known

as the Juran Trilogy for Quality Management: Quality Planning, Quality Control, and Quality Improvement (Gryna, Chua, & DeFeo, p. 20, note: it is important to understand that while the Trilogy is detailed in the reference noted, this reference is the fifth edition of Juran's work; the Juran Trilogy was expounded in the first edition, published in 1970 (personal communication, Tina Frigeri, 4 October 2017)). It is displayed in Figure 1.

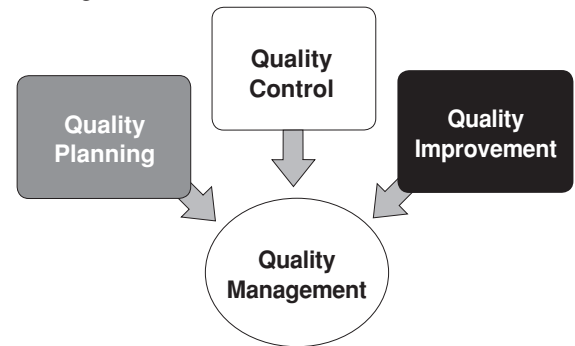


Figure 1. The Juran Trilogy

Further, in this work, Juran notes that Quality Engineering is part of Quality Planning and is thus categorized as preventive (noted in Figure 1.), and that part of Quality Control which actions are categorized as preventive, and Quality Improvement is reactive (noted in Figure 1.).

Juran also noted that, when failures occurred, Quality Engineering was, in the past, responsible for Quality Improvement; thus, quality engineers (QEs) had both preventive and reactive duties. However, the advent and implementation of Six Sigma programs have spawned structures separate from but parallel to that of the quality assurance departments, dedicated to improvement, including but not limited to quality improvement (Juran & Godfrey, 1999). Since Six Sigma programs are used for improvement not confined to quality assurance, six sigma black belts (SSBBs) come from many functions, including but not limited to, Quality Assurance. Consequently, despite the similarities of their requisite job skills (as defined by the ASQ BoKs), SSBBs do not always possess the depth of quality assurance oriented training or experience, as do pure QEs.

SSBBs, by nature of involvement with improvement projects are engaged in corrective

actions. QEs, having been relieved of responsibility for improvement, engage in purely preventive actions.

This situation has resulted in a dichotomy of effect: Preventive actions are by their nature more economical than corrective actions and, additionally, can be expected to reduce the number of required future corrections (Westcott, 2005; Zivalijevic, Bevanda, & Trifunovic, 2017), yet anecdotal evidence indicates that organizations reward improvement projects, and those responsible for them, more highly than those who affect preventive measures. In effect, organizations reward “fire fighting,” thus encouraging “arson,” rather than rewarding the building of fireproof structures. This is significantly costlier in long term.

The problem identified in this study: Companies are losing significant money focusing on corrective actions vs. preventive actions. The purpose of this study was to determine if SSBBs dealing with corrective actions are rewarded and recognized more than QEs who focus on preventive actions, even though the opposite manner of operation may provide for greater cost savings and thereby enable greater efficiency to the companies.

For this purpose of this study, the requisite job skills and consequent duties for QEs and SSBBs as used were best described by American Society for Quality (ASQ) in their respective Bodies of Knowledge (BoKs) for those certifications. In addition, the individuals involved in this study survey are assumed to be managers familiar with the job descriptions and requirements of both QEs and SSBBs but not directly performing either of these duties.

The data for this study was obtained through a mixed-method model

1. A survey of quality managers was conducted to determine the expectations and performance of QEs and SSBBs. The individuals responding to the survey were managers that supervise either QEs or SSBBs being familiar with the duties of both.
2. A Delphi Study, using the ASQ Certification Board members was performed, to determine answers to theoretical Quality Assurance concepts.
3. Finally, an analysis of the results of the ASQ Salary Survey results was performed, comparing the salaries of QEs and SSBBs.

The results of the Quality Manager survey and the Delphi Study were used together in order to provide inter-related and integrated construct validity, as well as cross-method reliability. These analyses were limited as the data sources gathered are all ASQ-oriented.

REVIEW OF LITERATURE

“An ounce of prevention
is worth a pound of cure.”

Benjamin Franklin.

“It seems obvious that an ounce of
preventive action costs much less than
a pound of corrective action”

(West, 2011).

The Juran trilogy notes that managing quality consists of three categories: quality planning, quality control, and quality improvement. Planning is almost exclusively preventive actions; Control is a mixture of preventive and corrective actions; Improvement is almost exclusively corrective actions. Each of these elements require a different approaches (Gryna, Chua, & DeFeo, 2007). Mixing these approaches may produce inefficiency (Arter, 2015).

The common element to all the reactive elements is that a failure occurs. No failures signify any necessity for correction; conversely, proactive elements of planning and control are always necessary.

Prevention vs. Correction

Current literature regarding business processes contains very little mention devoted to Quality Assurance in business environments. Academic literature is even more bereft: Odigie noted that there is little quality-related research as compared with other disciplines, such as chemistry and physics (Odigie, 2015). Even less information is dedicated to business prevention; in most cases, when “preventive” actions are described, there is incestuous clustering combining them with “corrective” actions; in almost all cases, the two are noted together. West and Cianfrani noted that some businesses simply to satisfy auditors, and search corrective actions to discover issues to characterize as preventive (West & Cianfrani, 2015).

This discrepancy illustrates a lack of understanding within the quality community of proactive problem prevention differentiated from actions taken to prevent recurrence.

Early Training in Quality Assurance

Early in a quality assurance professional's career, he/she is trained to the proper methods for affecting effective corrective actions. Improvement is a key factor of quality cost reduction; correction is a key factor of improvement (Benbow, Berger, Elshennawy, & Walker, 2002).

The descriptions in literature of an effective corrective action program, for example, section 10 of ISO 9001 (2015) and section 8 of ISO 13485 (2016), contain some variant inclusive of the following four steps:

1. Determine the nature and range of the non-conformance; identify and isolate the non-conforming items.
2. Determine what systemic error allowed the non-conformance to occur.
3. Disposition the non-conforming items, and;
4. Affect systemic corrective actions to prevent or reduce the likelihood of recurrence of the non-conformance. (International Standards Organization, 2015, 2016; *Juran's Quality Handbook*, 5th ed., 1999).

Work Experience

The indoctrination of the tools relative to proactive preventive actions is less extensive, and typically occurs later in a quality professional's career. West (2012) noted that there are three general methods to develop truly preventive actions:

1. Reduce complexity,
2. Manage risks, and;
3. Manage uncertainty.

Three key preventive tools to accomplish those methods are Statistical Process Control (SPC), Failure Mode and Effects Analyses: FMEAs

(AIAG, 2008; Guinot, Sinn, Badar, & Ulmer, 2017; U.S. Army, 1980) and error proofing.

Juran on Quality Improvement = DMAIC

In the current literature and practice, a model frequently used for implementation of improvement and corrective action is the Six Sigma process using the acronym DMAIC (Gryna et al., 2007; *Juran's Quality Handbook*, 5th ed., 1999; Khan, Badar, & Alzaabi, 2020; Taylor, Sinn, Ulmer, & Badar, 2015).

Six Sigma has been reported to have its origins at the Motorola Corporation in the early 1970s: Bill Smith determined the need for an organization, independent from but familiar with both the operations and quality assurance organizations, to provide profitable and ongoing improvement projects (Breyfogle, 2003). The investigatory, analytical, and communication tools used are common to both the CSSBB and the CQE BoKs, arranged in the order specified by the acronym DMAIC (ASQ, 2015a).

Investigation reveals that while Six Sigma purported to be a new method, it is in fact a repackaging of the methods for quality improvement first developed by Dr. Juran in the 1950s and first published in 1964; both in textbooks, the most recent edition of which is (Gryna et al., 2007); and in workbooks (Juran, 1982).

In the most recent edition of *Juran's Quality Planning and Analysis for Enterprise Quality*, the authors list Juran's quality improvement steps as presented in Table 1. and provide a translation for each step into the language of Six Sigma.

While Juran's names are not conveniently acronymic, Table 1. reveals that they accomplish the same objectives in the same order. The difference is that Juran's methods were established and published far earlier (Gryna et al., 2007).

Table 1. Translation from Juran on Quality Improvement to Six Sigma

Step	Juran's Quality Improvement Step Name	Six Sigma Step Name
1	Verify the Project Need and Mission	Define
2	Diagnose the Causes	Measure & Analyze
3	Provide a Remedy and Prove its Effectiveness	Improve
4	Deal with Resistance to Change	Improve
5	Institute Controls to Hold the Gains	Control

Comparison of the ASQ CQE and CSSBB BoKs

The respective ASQ BoKs for QEs and SSBBs provide standardization for comparing respective duties and responsibilities.

ASQ performs Job Analysis Surveys to keep the exams current and applicable. These were performed most recently in 2014 [ASQ CSSBB] and 2015 [ASQ CQE] (Carmen O'Neill, personal communication, 14 August 2018). The respective BoKs were developed therefrom.

The conclusions therefrom are based on both the similarities and gaps found, as follows:

- The two BoKs are relatively identical regarding many skills such as project management, leadership principals and techniques, lean tools, and classical technical techniques. The skills:
 1. Statistical Techniques such as Statistical Process Control (SPC),
 2. Design of Experiments (DoE),
 3. Probability,
 4. Test of Hypotheses,
 5. Capability,
 6. Regression, and;
 7. Measurement Systems Analyses (MSA),

are represented relatively equally and in largely equivalent levels of taxonomy.

However, there are gaps in the CSSBB BoK with regards to the conduct of day-to-day business for an operational organization. In addition, reliability, risk control, the Shewhart cycle, and the ASQ Code of Ethics are missing, all of which exist in the CQE BoK.

The applicable skills extant in the CSSBB BoK missing from the CQE BoK are a detailed taxonomy of how project teams work and non-parametric tests of hypotheses.

Based on this comparison of the two BoKs, which provide the standards for the positions, it is apparent that QEs are largely responsible for two of the three aspects of the Juran Trilogy: Planning and Control, while SSBBs are largely responsible for Improvement. It is also apparent that the clear majority of the CSSBB BoK is present in the CQE BoK, but the converse is not true.

Separation of Quality Engineering and Black Belt Roles

With the adoption and widespread acceptance of 6σ by large organizations, the program became a major part of total quality management (TQM) programs. The difference between 6σ and

previous TQM programs was the full-time staff parallel to the quality organization. 6σ facilitators are chosen from both within and without Quality Assurance, and given training in improvement methods (*Juran's Quality Handbook, 5th ed.*, 1999). Off-the-shelf statistical software provided assistance with or substitution for the requisite technical skills for those not so equipped (*Juran's Quality Handbook, 2010*). A four-week training period including instruction on how to use statistical software substitutes for the technical skills and experience was frequently required for QEs.

SUMMARY

Actions taken to prevent problem occurrence are proactive; actions taken to prevent problem recurrence are reactive. It is difficult to financially quantify the value of actions taken to prevent occurrence, since failures do not occur (Juran, 1982). It is easy to quantify the financial value of actions taken to prevent recurrence; all of 6σ were established to provide that calculation (Breyfogle, 2003). As a result of the division of the elements of the Juran Trilogy, QEs are largely responsible for the proactive actions; SSBBs are largely responsible for the reactive elements. It is widely accepted that true prevention is more cost effective than correction (West, 2011). However, due to its ease of financial determination, correction is anecdotally more widely accepted and rewarded.

There exists a significant research gap, especially in academic literature, regarding the differentiation between and use of preventive action and corrective action in business. Therefore, this study was intended to determine if SSBBs dealing with corrective actions are rewarded and recognized more than QEs who focus on preventive actions, even though the opposite manner of operation may provide for greater cost savings and thereby enable greater efficiency to the companies.

METHODOLOGY

The intent of this study is to determine if, per to the established dogma that proactive actions to prevent problem occurrence are far more economical, actions taken to correct and prevent issue recurrence are recognized more readily and rewarded more highly. Three separate quantitative analyses (Creswell, 2014) were performed; the intent of this method is to use the divergent analyses of each to mitigate biases and/or weakness of the others.

The intent of the separate but parallel approach is that collecting data from multiple sources provides a deeper understanding of the problem. The data was collected as follows (Short, 2019):

First, a survey was performed to determine methodologies and input from individuals familiar with the work and duties of both QEs and SSBBs. This was performed on site at the ASQ World Conference in Fort Worth, Texas in May 2019, using members of the Quality Management Division. By definition, management is responsible for subordinate organizational policies. Therefore, Quality Management is responsible for Quality organizational policies. The survey flow is shown in Figure 2.

Second, a Delphi Study (Dalkey, 1969) was conducted. A Delphi Study is a method of utilizing experts as advisors in decision making. It possesses three specific characteristics:

- Anonymous response,
- Iteration and controlled feedback, and;
- Statistical group response.

The concept was introduced by The Rand Corporation for the U. S. Air Force (Dalkey, 1969). The Delphi method is an important tool to identify and prioritize issues concerning managerial decision making (Alsibaei, Haridy, & Badar, 2019). A survey is circulated through a group of experts to minimize any bias or conflict in opinion. It's recommended to have responses from 10-18 experts to have a better reliable

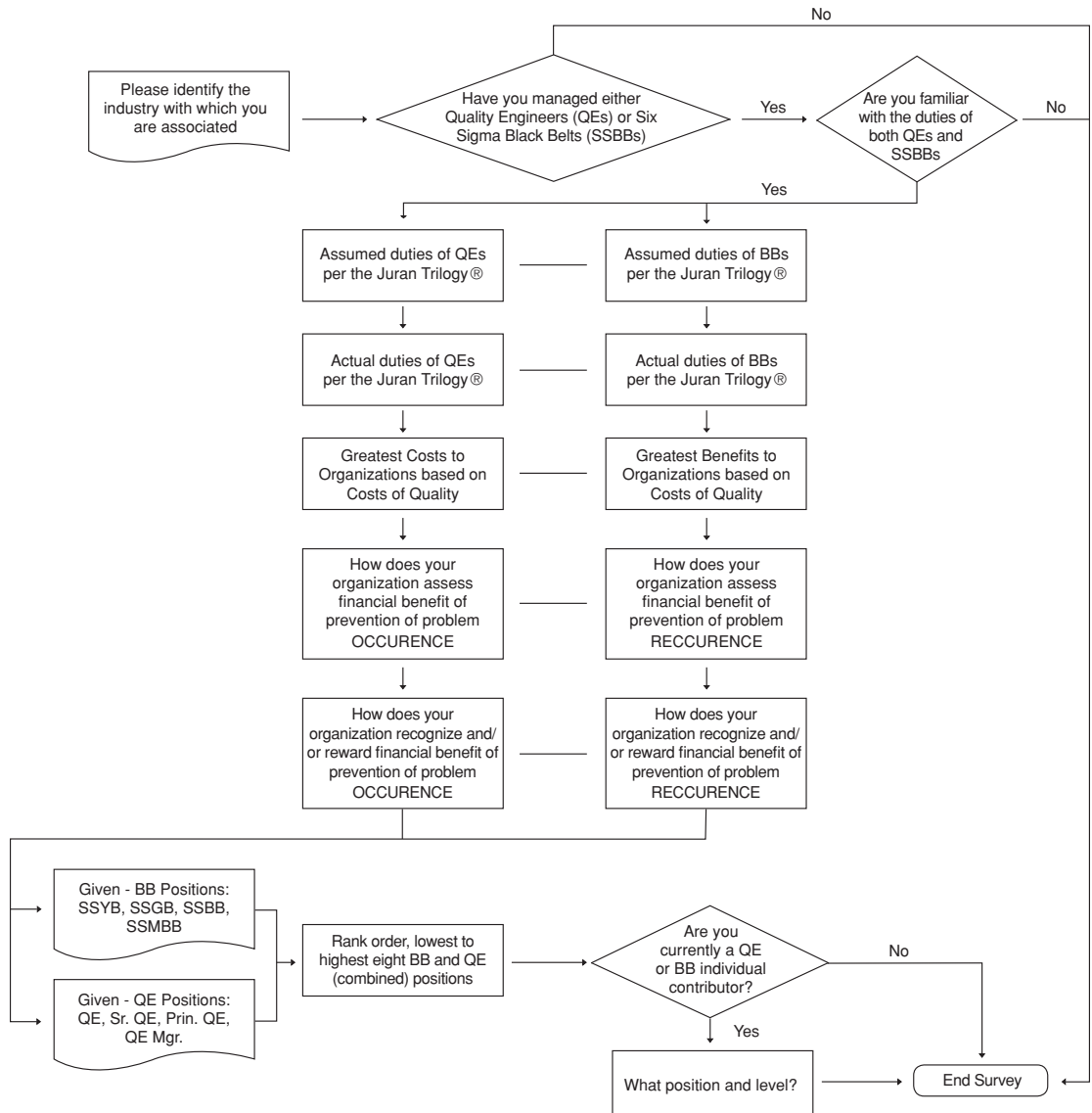


Figure 2. The Survey Items

result (Okoli & Pawlowski, 2004). However, Wynekoop & Walz (2000) in their study used only nine experts.

For this study the experts used were those responsible for the development and implementation of the BoKs of the ASQ Global Certifications Examinations: the ASQ Certification Board, during the annual meeting of the ASQ Certification Board at the ASQ World Conference in May 2019. Members of the Certification Board were used as the oracles.

The purpose of the Delphi study was to provide theoretical responses to the duties and expectations of QEs and SSBBs as well as provide a cross-reliability and validity check with the survey (Creswell, 2014). The five items to be resolved in the Delphi study are described in the “Findings and Analysis” section.

Finally, a comparison of salary data as gathered and published by the American Society for Quality (ASQ) in the annual ASQ Salary Survey, for equivalent levels of those two job titles, using the mean and standard deviation data presented for the past four years.

FINDINGS AND ANALYSIS

Overview

This section describes the results of the data collected from the three data sources:

- The Survey of the ASQ Quality Management Division,
- The Delphi Study of the ASQ Certification Board, and;
- The results of the ASQ Salary Survey for the past four years, for the position titles QE and SSBB, and how the analyzed data integrates.

The Survey

The first two non-administrative items dealt with the *theoretical* categorization of duties of QEs and SSBBs in terms of the Juran trilogy: Planning, Control, or Improvement. Of the 41 respondents that had managed either of the two positions, the view of QEs theoretical duties held that 80.48% of those duties concerned either planning or control. Of the 42 respondents that had managed either of the two positions, the view of SSBBs theoretical duties held that 80.95% of those duties concerned improvement.

The next two survey items dealt with the *actual* categorization of duties of QEs and SSBBs per the Juran trilogy. Of the 40 manager respondents that responded, 72.50% held that QEs actual

duties concerned either planning or control. Of the 42 manager respondents that answered this item, 80.95% held that SSBBs actual duties concerned improvement.

The next two survey items asked which of the four quality costs *Prevention*, *Assessment*, *Internal Failure*, and *External Failure* afforded the greatest financial costs and greatest financial benefits to an organization. A majority of the respondents (80.28%) held that of the quality costs categories, actions related to failures (internal and external) constituted the greatest financial costs to an organization, whereas 90% of the respondents held that actions related to prevention constituted the greatest financial benefits to an organization.

The final non-administrative survey item asked the respondents to provide their perceived rank order, from lowest to highest relative ranking, of four relatively common positions in a quality assurance organizational structure: quality engineer (QE), Principal QE, QE Manager, and Senior QE Manager; and four relatively common positions in a Six Sigma (6σ) organizational structure: 6σ Yellow Belt, 6σ Green Belt, 6σ Black Belt (SSBB), and 6σ Master Black Belt. While eight total position titles were compared for this item, the item’s true purpose was to compare the relative perception of ranking between QEs and SSBBs; the additional position titles included were used as camouflage for that true purpose.

While this item used ordinal data, the concept of relative ranking, the large sample size ($n = 72$) and the effects of the central limit theorem (that the means of all distributions approach normality as the sample sizes increase) affords its use as interval data. Consequently, the responses were arranged as whole integers from one (lowest) to eight (highest) with the perceived data calculated as average values. See Figure 3 on page 58.

It is important to note that the largest step between positions is that between QEs (3.028 perceived ranking) and SSBBs (4.437 perceived ranking), the comparison of interest for this work.

The Delphi Study

The Delphi Study concluded the annual meeting of the ASQ Certification Board (18 May 2019), using the chairs of the ASQ Certification Examinations (the individuals that control the BoKs for all ASQ Certifications), as the oracles.

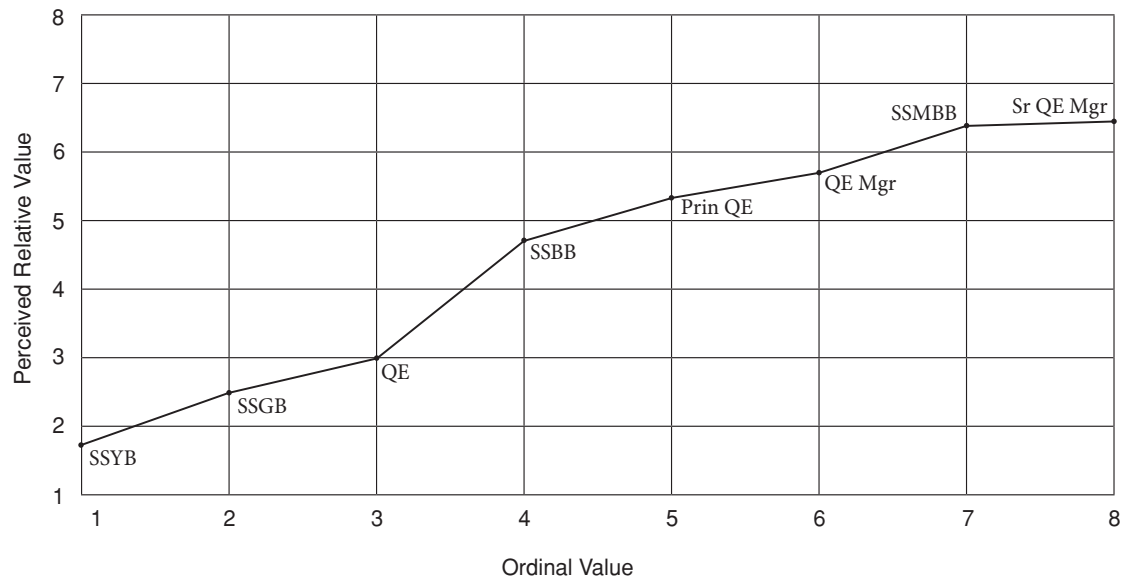


Figure 3. Relative Perceived Rankings of Positions

The final results of the five Delphi Study items were as follows:

Question 1:

What are the preferred tools for determination and implementation of corrective actions (actions to prevent recurrence of problems)?

Consensus Response:

- Root cause tools (e.g., 5-Why analyses, Fish-bone Diagrams, Brainstorming),
- Implementation Plan (e.g., RACI, Tasks, schedule, Effectiveness [Validation &Verification] check, Business Cases and Budgets, VOC),
- Record of the plan implementation, Plan vs. Actual, with management reporting.

Question 2:

What are the preferred tools for determination and implementation of preventive actions (actions to prevent occurrence of problems)?

Consensus Response:

- Control Charts,
- FMEAs,
- Horizontal Lessons Learned,
- Control plans,
- Go & See,
- Reliability Engineering,
- Measurement Systems Analyses,
- Risk Registers,
- Implementation Plans (e.g., RACI, Tasks, Schedule, Effectiveness [Verification &Validation] checks, business case and budget, VOC),

- Record of the plan being implemented,
- Plan vs. Actual comparisons, with administrative reporting,
- Prioritization Matrices,
- Preventive Maintenance,

Question 3:

How does an organization best assess the financial value of actions to prevent recurrence of problems?

Consensus Response:

- Failure Costs,
- Cost Benefit Analyses.

Question 4:

How does an organization best assess the financial value of actions to prevent occurrence of problems?

Consensus Response:

Determine how much we'll spend to predict the prevention, but do not know the value of the problems prevented, with the exception of a comparison with a like event.

Question 5:

What are the best Quality Assurance models currently in use that may describe the various common Quality Assurance job descriptions?

Consensus Response:

None Known

The Salary Survey

ASQ performs an annual salary survey for its membership, based on several criteria. The comparison used for this work is that between the position titles of QE and SSBB. The pertinent data from the last four years of surveys is presented in Table 2.

SUMMARY AND CONCLUSIONS

The problem identified in this study is that companies are losing significant money focusing on corrective vs. preventive actions; therefore, there is a need to determine the potential for significant cost savings. A quantitative method was used to determine if companies reward and recognize corrective actions more than preventive actions, encouraging associates to prioritize corrective actions, even though the opposite manner of operation may provide for greater cost savings and thereby enable greater efficiency.

Summary of Data Analytical Methods

For comparison purposes, standard hypotheses testing of proportions and means (for items with two choices) and chi-squared goodness of fit test (for items with more than two choices) was employed to determine level of statistical significance. The level of confidence employed was 95% (i.e., Type I risk = 0.05).

Summary of the Data Analysis

Research Question 1:

“Which of the two actions [prevention v. correction] does organizational quality management prescribe more highly?”

Survey Items 4 and 5 asked respondents to *theoretically* classify the duties of both QEs and SSBBs using the three processes of the Juran Trilogy. A two-sample proportions test noted a statistically significant difference between the duties of a QE and a six-sigma black belt, both *theoretical* and *actual*:

Thirty-three (33) of the 41 respondents classified the *theoretical* duties of QEs with either planning or control (those the Juran Trilogy identifies with prevention); and 34 of the 42 respondents that had managed either of the two positions, the view of SSBBs *theoretical* duties held that 80.95% of those duties concerned improvement.

Twenty-nine (29) of the 40 management respondents classified the *actual* duties of QEs with either planning or control (those actions in the Juran Trilogy that identify with prevention); Thirty-four (34) of the 42 management respondents classified the *actual* duties of a black belt improvement. A two-sample proportions test noted a statistically significant difference between the *actual* duties of a QE and a six-sigma black belt.

Survey Items 8 and 9 asked respondents to identify which actions related to costs of quality incur the greatest costs and benefits respectively to organizations. For cost to organizations, of 71 total respondents, 9 identified prevention, 5 identified assessment, and 57 identified failure (either external or internal). A chi-squared goodness of fit test demonstrates that failures are statistically significantly higher than the other two costs.

For benefits to organizations, of 70 total respondents, 63 identified prevention, 4 identified assessment and 4 identified failure. A chi-squared goodness of fit test demonstrates that Prevention offers a statistically significantly lower cost than the other two costs.

Discussion of Research Question 1:

The results of the survey clearly differentiate (with statistically significant differences) the duties of a QE, both *theoretical* and *actual* as those duties categorized with prevention, from those of a SSBB, both *theoretical* and *actual*, as those duties that categorized as correction.

Table 2. ASQ Salary Survey Data (\$US) for the United States for the Years 2015 – 2018 (Hansen, 2015), (Hansen, 2016), (Hansen, 2017), (Hansen, 2018)

	Year											
	2018			2017			2016			2015		
Position	n	Average	Std Dev	n	Average	Std Dev	n	Average	Std Dev	n	Average	Std Dev
QE	732	\$84,944	\$22,696	764	\$85,974	\$25,519	914	\$83,991	\$25,523	990	\$82,124	\$23,532
BB	77	\$102,593	\$24,536	96	\$101,785	\$33,357	109	\$98,445	\$24,120	140	\$97,042	\$22,813

Further, the survey results differentiate sources of greatest costs (failures) and greatest benefit (prevention).

Conclusion of Research Question 1:

Quality managers inherently understand the advantages of prevention over correction, and that prevention is largely the purview of QEs; correction is largely the purview of SSBBs.

Research Question 2:

“Which of these two types of actions (preventive and corrective actions) does organizational quality management demonstrate to value more highly?”

The ASQ Salary Survey data, noted in Table 2., for the past four years reveals statistically significant differences. Comparisons by year show that for every year examined there is a statistically significant difference between the mean salary of a SSBB and a QE in 2018, and SSBBs were paid more.

In addition, survey Item 14 rank-ordered the relative perceived ranking of QEs and SSBBs, along with three other position titles in each of the QE and 6 σ organizations.

Consequently, there is a statistically significant difference between the perceived relative ranking of QEs and SSBBs, and SSBBs were perceived to have higher relative ranking.

Conclusion of Research Question 2:

The comparative salaries of SSBBs and QEs indicate with statistical significance that SSBBs are consistently paid more, over the examined four-year period, and the relative ranking item on the survey indicates that SSBBs are perceived to have a statistically significantly higher relative ranking.

Research Question 3:

“Should a statistically significant disparity between management’s purported values and demonstrated values regarding preventive and corrective actions be determined, to determine correction for that disparity, what root-cause factors contribute?”

The Delphi Study provided the pertinent information:

The response to Delphi Study Item 1 listed the preferred tool for determination and implementation of corrective actions. That list is brief and well established; as noted above, the tools for corrective actions are well known to quality professionals.

The response to Delphi Study Item 2 listed the preferred tools for determination and

implementation of preventive actions. That list is significant in both length and relative lack of widespread familiarity to quality professionals. During the discussion it was noted that many of the tools listed were largely theoretical and sporadically used.

The response to Delphi Study Item 3 listed the preferred ways to assess the financial value of corrective actions. The list is significant in its brevity, and that the tools listed are reaction based, and consequently are quantitative, based on known costs.

Finally, the response to Delphi Study Item 4 was indicative of the problems inherent to assessing the financial values of prevention. The consensus response that, lacking a known cost comparative event, there is no way to assess the financial value of preventive actions.

Conclusion of Research Question 3:

The Delphi Study and Survey provide interdependent validity and reliability, as their responses provide mutual support. Both instruments note that assessing the costs and value of prevention as difficult and that assessing the costs and value of correction as rather straight forward. Ultimately, as quoted in Chapter 2, Juran’s admonition that the language of management is money (Juran, 1982), and preventive actions cannot be easily financially quantified, even though quality managers understand them to be more cost effective. Consequently, managers concentrate on what they can quantify, and reward it accordingly.

Research Question 4:

“Do any well-known quality models describe or explain these results?”

Unfortunately, the oracles could not find any such well-known quality models.

Conclusion of Research Question 4.

The primary conclusion of this research question is that a model to describe or explain these results wasn’t known or considered. This required the author to respond.

The simplified Kano model noted by Figure 4 on page 61 consists of three kinds of design requirements (delighters, satisfiers, and dissatisfiers) plotted a Cartesian grid with the horizontal being levels of provision of the requirement, and the vertical axis being customer satisfaction.

Delighters are features that the customer doesn’t expect and doesn’t specify, but provide significant satisfaction when provided,

increasing at a greater than linear rate. Satisfiers are features the customer specifies over basic expectations, and the customer satisfaction with their provision is linear. Dissatisfiers are those basic features the customer expects without specification, and impact satisfaction negatively when missing (Tague, 2005).

The survey, the Delphi Study, and the Salary Survey analysis results point to the conclusion that while prevention is understood to be more cost effective, it is difficult to quantify and thus difficult to recognize and reward, rendering successful prevention by definition a basic expectation, a dissatisfier. On the other hand, correction is relatively easy to quantify financially especially when improvement projects quantify the cost savings. Thus, by definition, they become either satisfiers: something positive the customer (management) specified, or delighters: something positive the customer didn't specify but got anyway.

Prevention is difficult to quantify financially; is a basic expectation and is thus a dissatisfier by definition. Correction is easy to quantify financially; a response to a specification or a pleasant surprise and is thus either a satisfier or delighter by definition. Consequently, the Kano Model explains the results.

OVERALL SUMMARY

The results noted above demonstrate that despite a nearly identical expectation of skill sets, as found the ASQ BoKs for QEs and SSBBs, current expectations of duties have QEs performing largely preventive actions and SSBBs largely corrective actions.

In addition, these results demonstrate that while managers understand the relative value of preventive over corrective actions, they recognize and reward corrective actions more highly. The overall practical consequence is that this disparity results in largely unquantifiable loss to organizations, which presents several practical implications to business organizations:

- Business organizations must understand these results, and that losses are occurring.
- Business organizations should investigate and determine the comparative orders of magnitude of the losses that occur. As organizations reward correction over prevention, savvy individuals have emphasized corrective over preventive actions to gain greater recognition and reward. Understanding of the magnitudes of this disparity will allow organizations to correct the disparity.

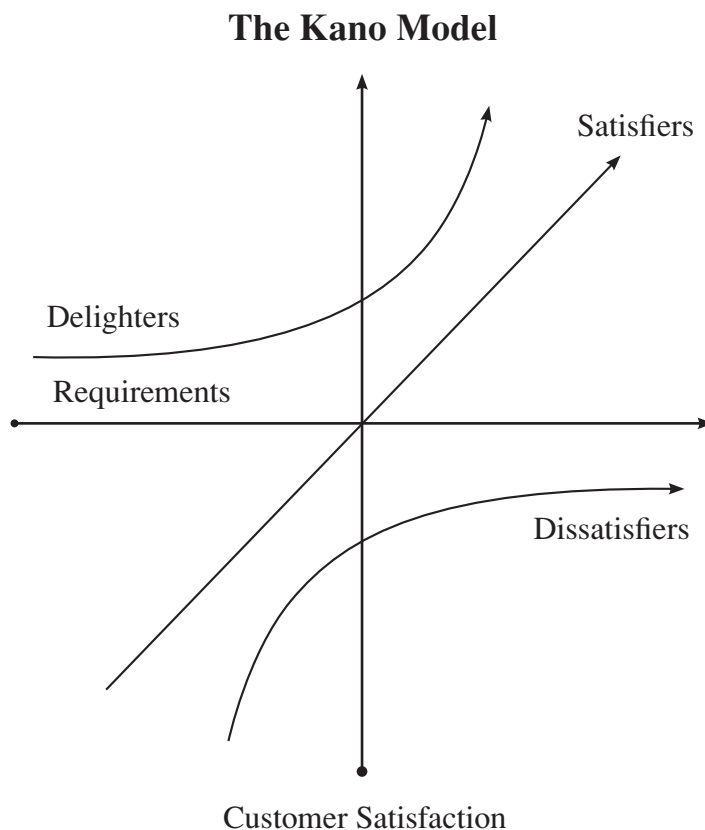


Figure 4. The Kano Model

- Business organizations must implement systems for understanding and recognizing preventive actions. While this change will not be easily implemented, due to the relative difficulty in calculating preventive value in the “language of management” (money), it is necessary for the reduction or elimination of the largely unquantified losses incurred due to the current emphasis of recognition and reward of correction.
- Finance departments must be prepared and qualified to apportion the recognition of prevention over correction. Prevention, in finance terms, is labeled as “Cost Avoidance,” which finance organizations are loath to recognize, whereas correction is labeled as “Cost Savings,” which finance organizations are quick to recognize. For these unquantified losses to end, both “Cost Avoidance” and “Cost Savings” must be calculated and recognized with equal diligence.

The results of this study indicate that the underlying model that usefully demonstrates this concept is the Kano model. It successfully demonstrates why correction is rewarded more highly than prevention. Further study is recommended to refine and replicate these results and develop tools or techniques to assess both the tangible and intangible benefits of prevention, in order to facilitate its increased employment.

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