A Proposal of New Scientific Methodology to Improve the Principle of TQM

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Abstract

Various successful TQM procedures have contributed to solve the problems in actual business, but recently it is required to more speedily perform the improvement activity and to challenge solving foreseen latent engineering problems in addition to existing ones. This paper proposes a new scientific methodology which enables us to perform the requirements and to improve the principle of TQM. The performance of the proposed method is illustrated through same practical studies.

1 Introduction

TQM (Total Quality Management) is a system of methods for cost–effective provisions of goods and services whose quality is fit for the customer's requirements so that it consists of essentially developing, controlling, and assuring the quality of products and services, and means improving the quality of everything, e.g. the quality of company, the quality of executives and departments, the quality of sales departments, factories and laboratories. However, since our work is affected by an infinite number of different factors, it is impossible to manufacture products without any variation. One of the first steps in TQM is deciding what to make in order to satisfy customer needs in terms of statistically distributed quality of product lots. Statistical ideas and methods are extremely useful for balancing market research information with existing technical knowledge, factory technical levels, and process capabilities in order to set quality with a reasonable degree of variation.
Recently, it is of importance to challenge the various kinds of customers' needs or the manufacturing production demands, and it is expected that the TQM activity is to solve foreseen latent engineering problems in the actual business in addition to existing ones.

To answer this expectation it is important to develop a new scientific methodology which can scientifically clarify implicit technical knowledge concerning to pending chronic and bottleneck engineering problems so as to contribute to the development of new technologies, processing methods and materials.

In this paper, we propose a new scientific methodology which enable us to speedily solve the problems above and will improve the principle of TQM systematically. The performance of the proposed method is illustrated through studies and practices at a company.

2. Review on quality management methodologies

Statistical methods are continuing to make great advances, and offer a familiar set of quality management methods. The statistical methods used in TQM make up what is called statistical quality control (SQC) methods, and include the seven quality control tools, the control chart, sampling inspection, statistical testing and estimation, analysis of variances, correlation analysis, regression analysis, design of experiments, multivariate analysis, and reliability techniques, sensory techniques, and OR methods.

SQC methods consist of numerical analysis to obtain information from a random sample drawn from a population and establish measures and actions for the population. They are effective in revealing the deterministic, reproducible relationships hidden in numerical data. SQC methods have the following functions:

(1) systematic analysis of the cause of defects,
(2) standardization of job know-how in workshops to ensure correct work, and
(3) facilitation of correct decision making despite small individual differences resulting from dispersion.

Of the SQC methods, seven tools that are easily used in a wide range of applications have been selected for utilization in QC circle activity in manufacturing workshops. They are called the Seven QC tools (Q7), and consists of

(a) Pareto diagrams,
(b) cause-effect diagrams,
(c) the idea of stratification,
(d) check sheets,
(e) histograms and frequency distributions,
(f) scatter diagrams, and
(g) graphs and control charts.

As applications of TQM extended in various fields, a number of problems arose that could not be solved by the SQC methods alone. For example, there are questions of "what are the true customers' needs," "what is an attractive service for a customer," and the problems related to the quality of design and service, "what vision of the future will motivate employees to be self-starters and work on their own initiative," "how to acquire new customer," "how to further stimulate QC circle activity," and so on.

To answer these questions, information has had to be obtained from data expressed in language(language data, in short), and new methods have been develop. For instance, seven management tools for quality management (N7) which consists of

(a) affinity diagrams,
(b) relation diagrams,
(c) tree diagrams,
(d) matrix diagrams,
(e) matrix-data analysis method,
(f) process decision program charts(PDPC), and
(g) arrow diagrams,

and quality function deployment (QFD), failure mode and effects analysis (FMEA), and fault tree analysis (FTA) have been developed.

3 Why a new methodology is required?

Ishikawa[1] says in his section 4.4 " If we know what a particular problem is and what our objectives are, the problem is already half solved" and Nayatani[2] says "It is more important thing to know what a particular problem is" at page 23. Then Ishikawa[1] proposes to use cause–and–effect diagram (fisher–diagram) and Q7, and Nayatani[2] recommends to use N7, especially the affinity diagram and/or the relation diagram, and the methods of multivariate statistical analysis.

They emphasize that the first step in the problem–solving activity is to clarify the nature of the problem, to clarify the structure of the problem, to search for the causes of a defect, and to deploy means to achieve the objective, to design the process of deployment of the means, and to predict the difficulties in the problem–solving process by investigating the relationship between causes and results, or objective and means.

It is well recognized that the most important factors in problem–solving activity are
(1) to attain objective speedily,
(2) to not include insignificant process, and
(3) to contribute to the prevention of other problems,
and both the application of a cycle of PDCA (Plan, Do, Check, and Act) and the use of the QC–story are most useful←$B!%←(B

However, reviewing our problem–solving process, it is frequently experienced that we have carried out unnecessary actions not related directly with the problem–solving activity. For example, in the R&D of a new product, an original technical problem to be solved varies responding to the change of the process or times and finally we may have to investigate so many technical problems. This situation is encountered in our chess game where there are so many move to be considered, but most of them are used only to confirm the validity of our finally selection. In the case of the game a considerable procedure to deduce the number of these unnecessary moves may be to make progress in the game but in the problem–solving to use the facts that are obtained through previous SQC activities.

It has been experienced frequently that 99 percents of elements constructing a problem are solved but the problem can not be solved. In this situation PDPC is used to achieve a given goal when one faces a problem in changing circumstances by helping the appropriate decisions be made and allowing the original plan to be enhanced as the situation develops, or to establish means to avoid undesirable situations.

Finally, it is well recognized that SQC methods can be used to set up inductively a hypothesis through analyzing a random sample drawn from a population. It is also possible to improve the experiment and analysis plans by using N7 and simple SQC methods based on the investigation of accumulated technologies.

The methods of multivariate statistical analysis such as regression analysis, principal component analysis, factor analysis, or cluster analysis can be used to set up a kind of hypotheses by clarifying the structure or nature of the problem as is illustrated by Amasaka[3] and Yamarai and Ihara[4].

4 A new methodology

As described in the section 2, it is well known that SQC has played an important role so far in the applications of TQM. It is the primary objective of SQC to enable us to attain our difficult problem related to QCD, quality (Q), cost (C), and delivery (D), through the knowledge obtained by applying SQC to scientific and inductive approaches in solving our important problems in addition to the conventional deductive or theoretical method.

However, since we are required to improve the total business process globally and speedily by the rapid innovation of technologies, changes in the corporate environment, and customers' needs, we have to develop a new scientific method which contributes to solve foreseen latent engineering problems in addition to existing ones. To answer these requirements, it is necessary to improve the stage of planning in the problem—solving activity, which is attainable through the combination of N7 with SQC methods.

SQC methods should be used when the nature of a problem calls for collection of numerical data and statistical problem solving, or when a more accurate conclusion can be obtained through the numerical analysis, while N7 is recommended when the nature of the problem can be expressed only in language, or when the problem lends itself to clear verbal articulation.

SQC methods are designed to collect facts in the form of numerical data, and the required information is obtained through statistical analyses. Using N7, it is possible to collect the facts in the form of language data to obtain the necessary information. Combined use of conventional SQC methods and N7 will make easier to solve the problems that arises in TQM activities. Furthermore, it is possible to make more easily by proactive combination of the design of experiments with the methods of multivariate statistical analysis amalgamated with engineering technologies.

Our previous discussions are summarized as follows: it is the most important thing to set up a sort of hypotheses with respect to the structure or the nature of the problem, and it is possible to attain by combining the abductive approach by using N7 with the inductive approach by SQC in addition to the conventional deductive approach.

5 An application of proposed new method

Since the law about patent was revised in the United States of America in1989, it has been difficult to export cars produced in Japan using the patents developed in USA. Therefore, it is of importance for a motor corporation to develop policies allowing engineers to develop a good investigation and get a good patent. In order to develop such polices it is necessary to investigate what the good investigation is.

For this objective, we make up questionnaire in the following steps:
(1) Implementation of a preliminary questionnaire about engineer's opinion,
(2) Analysis of their opinions using the affinity diagram, and
(3) Design of questionnaire.

Given a sample of 93 engineers from 6 different divisions, we made three subgroups of individuals by using the cluster analysis method, and then we can extract three important latent factors by using the method of factor analysis. Finally, we can construct an important policy to motivate engineers to develop their good investigation and get their good patent. See, Ihara and Amasaka[5] for detail.

In this study, it was the most essential thing to set up a sort of hypotheses with respect to " what the good investigation is for engineers" and not to use the method of factor analysis, i.e., it was the most important thing to improve the design and analysis plans through applying the abductive approach by N7 and the stratification by the method of cluster analysis.

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