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Proposal and Implementation of the "Science SQC" Quality Control Principle

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Abstract—In forecasting the operation of the manufacturing industry in the 21st century, the authors recently proposed "science SQC" as a demonstrative-scientific methodology and discussed its effectiveness on the basis of verification studies conducted by Toyota Motor Corporation. This study outlines a new SQC principle "science SQC", as a demonstrative-scientific methodology, which enables the principle of TQM to be improved systematically. © 2003 Elsevier Ltd. All rights reserved.

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1. INTRODUCTION

To promote quality control that contributes to the world in the future, it is necessary for us to carry on lucid and reasonable TQM activities that will enhance the business process of all departments. To do this, it is important to give thought to quality control of the manufacturing industry in the future, change the principle of TQM activities accordingly, and show a good example so that a brighter future may be obtained.

In this connection, the author proposed "science SQC" as a demonstrative-scientific methodology and discussed the effectiveness of this method which improves the systematic development of the principle of TQM [1–3]. This paper positions the proposed "science SQC" as the "next generation TQM (TQM-S)" that improves the principle of TQM and verifies its effectiveness through development at Toyota and subsequent results.

2. NEED FOR NEW SQC TO IMPROVE THE PRINCIPLE OF TQM BY MANUFACTURING INDUSTRIES

2.1. Delay in Systemization of Quality Management System That Improves Manufacturer's Management Technology

It is generally agreed that quality management activities have contributed largely to Japan's economic prosperity today. Quality management by manufacturers originated in Japan when

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statistical quality control (SQC) was introduced, used and deployed by Shewhart [4] and Deming [5], who proposed that "quality management began and ended by control chart" [6], which is the basis of "quality built into process" [7]. These activities and results were advanced by Juran [8,9], systematically advancing the concept and progress method of the company-wide total quality control (TQC) activities. This TQC has further advanced to today's total quality management (TQM) activities [10].

In the 1980s and after, U.S. companies were stimulated by introductions made by Gabor [11] and Joiner [12] and an MIT [13] report to change the concept of quality from product quality to quality of customer's sense of value by learning the quality management system in Japan. There, they reviewed Japanese-style cooperative activities and the effect of SQC as a scientific approach and deployed the new quality management nationwide, while also receiving instructions from Deming.

In the 1980s and 1990s, however, Japanese manufacturers were too caught up in the economic boom both in Japan and overseas countries that they did not necessarily establish management technology bases sufficiently to prepare for the next generation. They put too much emphasis on JIDOKA (automation), introducing large-scale equipment, and taking a long period of time and large investment for completion, transforming the production system accordingly. As a result, the production system became nonprofitable. Some companies put too much importance on automatic adjustment with equipment having automatic adjustment functions even if 5M-E (man, machine, material, measuring, and method-environment) deviate. In others, control charts simply disappeared from their manufacturing processes, reducing the scientific process management level.

As the situation continued, it became increasingly difficult to check the workmanship of products currently under production in real time. Not only for the production division, but also for the product design, production engineering, and quality assurance divisions, workmanship became difficult to confirm. It seemed that the process of maintenance, management, and improvement cycle did not turn well, as the skill and problem solving capability of workshops, supervisors, and auditors that could be improved through "observation of actual products" and "processes built into processes" had been abandoned for the reasons described above [14].

As alerted by Goto [15], Japanese manufacturers forgot the origin of quality management in the latter half of 1980s toward the early 1990s, resulting in a slowdown in growth. The most important factor was the delay in systemizing next-generation type management technology to be developed and introduced in accordance with technical advancements and changes occurring in the management environment around each manufacturer, making the whole Japanese industry fail to establish a new method (reasonable and scientific method for quality management) capable of improving the management technology. These are discussed in more detail by Yoshida [16] and Amasaka [17].

2.2. Necessity of New SQC as Demonstrative Scientific Methodology

The secret of successful quality control activities on the part of the manufacturing industries aimed at providing customers with attractive products consists of a reasonable way of thinking about quality control and the actual procedure to be established and followed accordingly. To be more precise, it means correctly converting customers' wishes (tacit knowledge) into engineering terms (explicit knowledge) by using the correlation technique and so on, replacing it with well-prepared drawings, and enhancing the process capability for early embodiment into products.

In retrospect, the transition of quality control that developed from the manufacturing industry initially started with application of the mathematical method of SQC. It then developed into TQC using control technology, and more recently, into TQM using various management control techniques comprehensively. And the concept of quality has been undergoing expansion from conventional product quality-orientedness to business process quality, before becoming management technique quality-oriented. Along with this, the area of quality control activities expanded.