Toward the Factory of the Future
H.-J. Bullinger, H. J. Warnecke (eds.)

MANAGEMENT AND QUALITY CONTROL

by

Leif C Svensson
Department of Industrial Management
Chalmers University of Technology
S-412 96 Göteborg, Sweden

Abstract

This paper summarizes data from a three-year project in a Swedish forging plant. The results showed that although the operators had received a higher level of competence through training, only a 20% reduction of the quality defects was achieved. This stresses the fact that management controllable defects comprised the major part of the quality defects. Management controllable defects are, however, usually of such a nature that the total quality level is little affected by the operator's level of competence. In order to achieve better results it is necessary that measures be taken which affect the actual causes of the defects. The implications are that the majority of efforts to raise the quality level in a production process should be made at management level. It is not sufficient to educate the operators only. Design engineers, production technicians and others who may affect the results must be educated to be able to take their share of the responsibility.

Introduction

From a historical point of view the quality level in the production process has been "taken for granted". Thus, very few measures have been taken to "work out" the quality problems. In the last decade the quality level and quality control have become thought of as increasingly important because of the growing competition on the market. It is no longer sufficient to have a high quality level. Emphasis must be placed on measures to increase quality even further. During the 60's and 70's many manufacturing companies in Japan have tried various measures for increasing quality, including quality control circles (QC-circles) and Zero-defect programmes (1, 2, 3). These activities showed that the quality level of a product is very much dependent on the product design and the capability of the equipment. They also showed that very few of the quality defects are operator controllable. This indicates that the majority of the quality problems in manufacturing can be classified as management controllable. The case in this paper also indicates that the highest potential for increased quality is to be found at the management level in a company.

Quality Control Theory

The emphasis in traditional quality control theory was on measuring the quality level. In the last decade the concept of Total Quality Control (TQC) has become more dominant in the control of the manufacturing process.

One aspect of the TQC concept is the division of the causes of quality defects into management controllable and operator controllable (4).

It is often claimed that a low quality level is explained by the operator's low motivation for, interest in, and care for his work, but the situation is not so simple. Previous research has shown that only 20% of the defects depend on errors made by the operator.

Operator controllable and management controllable defects

The distinction between operator controllable and management controllable defects can be described as follows. A quality defect is classified as operator controllable if the operator can affect the quality level in the manufacturing process. If he cannot do so, the defect is classified as management controllable.

The question of whether or not the operator can affect the quality in the manufacturing process can be answered by examining the following three statements (4, 5):

The operator:
- knows what he is supposed to do
- knows what he is doing
- can regulate the process.

If the three statements above are fulfilled and a defect occurs it is operator controllable. If any one of the requirements is not fulfilled the operator cannot be held responsible for the defect.

Management controllable defects can be divided in three groups.
These are defects at the:
- design level
- subcontractor level
- equipment level.

When a defect can be referred to one of the groups above, the operator is not normally in a position to affect the results. There are two ways to eliminate management controllable defects:

a) eliminate the cause of the defect
b) make it possible for the operator to compensate for the defect in the manufacturing process.

Measure a) is often both difficult and expensive to carry out, because the production equipment must be replaced, the product redesigned, or subcontractors changed, etc. However, it is certainly to be preferred for a long-term solution of quality problems. A more short-sighted solution is to implement measure b), giving the operator the opportunity to compensate for the defects in the process. In order to give the operator this opportunity he must have a "tool" to compensate for them with. This might be training about the production process, the production equipment, or quality control techniques, etc. This tool could also be some sort of simple device to regulate the process or to measure the quality level.

Design level of the product

Design level means ease of manufacturing. A high design level means that the product is easy to produce. However, a product with a low design level can be manufactured with high product quality, if the manufacturing process is good. In other words it is possible to compensate for a low design level with a good process (fig. 1).

Equipment dependent defects

The status of the equipment is very important to the manufacturing quality. It is also very difficult for the operator to compensate for equipment dependent defects. They can be divided into wear and adjustment defects. Defects dependent on wear can be observed by the operator if he has the appropriate devices and knowledge for identifying them. It is very hard for the operator to compensate for them, and in most cases it is easier to replace the worn component. Adjustment defects are easier to observe and the operator can compensate for them if he has the appropriate knowledge of the equipment.

Case study

Background

This case study was carried out in a three-year project between 1980 and 1983, in a Swedish forging plant. The plant, with its production quantity of 13,000 tons, is the second largest forging plant in Sweden. The production consists mainly of components for the automotive industry in Sweden. The components produced are of low weight (from .5 kg to 8 kg), and they are of extremely varied types, from cog-wheels to front-wheel spindles.

The company uses the press forging technique, and has six press forging groups each manned by four operators (see fig. 2). The operators in the working group rotate among the different tasks in the group at 15-minute intervals. One reason for this is that they do not want to be bound to the machine the whole time.

Method.

The material analysed in this study is from 1981. The aim of the study was to find explanations for the quality defects. Our initial hypothesis was that the quality defects were management controllable and not operator controllable. In order to test this, the total production was analysed, to determine if there were any cause and effect links between the variables used to describe the material. The material was analysed statistically using the Statistical Analysis System (SAS).

To check for the operator controllable defects the operators were trained. The training consisted of better knowledge of the machines, process, tools, and quality control techniques. The total training time was 12 hours (7).

Analysis.

This material contains 111 different products, produced in annual quantities of 100 to 800,000 units. In some parts of the analysis products with an annual production of less than 5,000 or more than 225,000 units have been excluded. The first group consists mostly of spare parts (24 different ones) and the second group is two extremely high volume products (one with 393,000 and one with 795,000 units a year).