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INTEGRATION OF ROBUST DESIGN AND STATISTICAL PROCESS CONTROL (SPC)

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ABSTRACT

This paper will present a discussion of the advantages and problems of greater integration and interaction between the activities of product design, in an environment of Robust Design and production activities of the same product, in the context of SPC, it can be a contribution to future identification of approaches that are suitable for industrial contexts.

Keywords: product design, robust design, statistical process control (SPC).

INTRODUCTION

In an environment of traditional design, it is possible to analyze factors affecting a particular quality characteristic and determine its optimum levels. However, many characteristics of quality are affected by factors that are difficult to control in the stages of definition, conception and design of product detail, since they correspond to later stages, such as the manufacture or use. Nowadays, it is considered that the variability is the main cause of the lack of quality of products and processes and that the best time to solve this problem is in the stages of conception and definition. Stated another way, the products and processes must respond correctly to laboratory conditions, but also to normal manufacturing, operation and environment conditions in which they are subjected to various types of disturbances (or noise from various sources).

In Japan, in the early 60s, under the leadership of Dr. Genichi Taguchi, was developed a statistical approach to systematic improvement of products and processes. The method emphasizes the shift of the question of quality for the design phase, focusing on defect prevention through process improvement. Genichi Taguchi developed statistical models of experimentation, using fractional factorial designs, specific orthogonal tables and "experimental project" of response surface as accessories in the design and manufacture of products (Taguchi, 1987). The method emphasizes the importance of minimizing the variability as the principal means of achieving quality improvement. The process to achieve this through the use of statistical planning of experiments was called Robust Design. The Robust Design reduces variation simultaneously forwarding performance for an optimal scenario. When a product is designed to be robust, it must provide customer satisfaction, even when subjected to extreme conditions in manufacturing or service, i.e. it keeps the quality acceptable levels regardless of disturbances, whether these are due to manufacture (process variation) or external causes (environmental factors, utilization) or internal causes (deterioration or degradation) (Taguchi, 1986).

The four main points of Taguchi quality philosophy are:

1. In a competitive market, a continuous quality improvement and cost reduction are critical to the survival of businesses.

2. An important measure of the quality of a produced product is the total cost that this product infringes on society.
3. What society loses due to poor quality is approximately equal to the square of the deviation of its performance characteristic in relation to the purpose or par value.
4. The variation in performance of a product or service can be reduced if the observed nonlinear effects those factors (parameters) have on the performance characteristics.

DISCUSSION

The definition of the most important quality characteristics of a product and consequently the respective technical specifications are a concern of Robust Design, as well as the highest levels of the factors (controllable variables) process (Taguchi, 1986). But no less important is to ensure, in the later stages of the production cycle, capable processes, i.e., revealing ability to comply with these technical specifications. When we want to achieve in production settings found in the design phase, several questions are raised. First, we must ensure that the processes relating to various quality characteristics are stable, i.e., show a random evolution over time (the existence of only common causes of variation). The monitoring process is the advisable to check this stability, achieving this goal through the application of SPC (Statistical Process Control), using specific statistical techniques, the control charts (Pereira and Requeijo, 2012).

A second pertinent question, perhaps of greater importance, is whether the production is in accordance with the technical specifications that were defined in the design phase. The application of specific indicators, the so-called process capability indices, is the most effective way to respond fully to this question (Pereira and Requeijo, 2012).

A third concern is producing with minimal variability. The answer to this question is to define properly the best levels (values) of the factors (controllable process variables). The use of statistical techniques such as DOE (Design of Experiments) and Taguchi methods are approaches that are suggested for achieving this goal (Montgomery, 2005).

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