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THE PLACE OF DURABILITY CONTROL IN THE SYSTEM PRODUCT QUALITY CONTROL

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ABSTRACT

The notion of quality has acquired very broad meanings today and affects an important part of human activity.
The concept of quality was first attached to the core product of the activity of a single producer, then it evolved to the collective of products (lots) provided by a certain production process, to finally come to characterize the process itself.
Modern production is characterized precisely by "throwing" onto the market huge quantities of products of the same type. As a natural consequence, quality is no longer judged only through the lens of the product unit, but especially by considering the characteristics of batches of products of the same type.

KEYWORDS: durability, durability control, quality concept, modern production, product batches

1. INTRODUCTION

Although product batches claim a new conception in dealing with the notion of quality, this conception does not abstract from the intrinsic quality of the product, expressed by the so-called technical specifications, generally known to practitioners as ″specified tolerances″.

If for a product unit, non-conformance to specifications is translated into the actual measured or (found) deviation of the respective product from these specifications, non-conformity for a batch of products of a certain type is usually translated into the proportion (percentage) of objects that do not meet those specifications.

This is the key to understanding the role of statistical methods, which are the appropriate study tools for these communities.

The proportion of non-conforming products (the so-called defectives) when the production is of large series and mass (so theoretically infinite) is the essential characteristic of this production, and the information on the respective proportion can only be obtained through statistical reasoning that makes the transition from the sample to the population.

2. THEORETICAL APPROACHES

This paper proposes the following goals:

- one to fix the place and role of durability control in the wider framework of product quality control and to clarify the position of this discipline in reliability theory;
- to present practical methods of choosing statistical models that describe the durability of products
- must present practical control methods, accompanied by the necessary statistical tables, for each of the respective models

A discussion on the notion of sustainability is necessary because it is viewed differently by specialists belonging to relatively special fields of activity.

Likewise, the linguistic confusions that manifest themselves in statistical quality control and reliability theory, confusions usually due to not finding the most appropriate ″Latin″ correspondents of English terms, widely used in international literature, make a partial ″truncated" understanding that persists ″ of the respective concepts.

A relatively simple solution to this somewhat semantic problem can be done by using the variant in the Russian language of the Anglo-Saxon terminology, a variant not influenced by the French language, from which many notions of quality control and reliability have infiltrated, through takeover, directly into the Romanian language.

This is the case, for example, of the very meaning attributed to ″quality control″ (as quality inspection or verification) or ″quality management″, a concept that entered the Romanian language as a ″word for word″ translation of ″quality management″, without it was emphasized that in French it is adopted more as a reaction to the term with ″quality control″.

It is also useful to state that in fact the theory of operational safety means two relatively distinct disciplines in terms of goals and methodologies. It is the so-called ″life-testing″, which encompasses the specific procedures intended to test the durability of technical components and the theory of reliability itself, which includes the methodology for analyzing the operational safety of complex systems.

The concept of durability is widely used in engineering, but regardless of whether it is used in reliability or the theory of strength of materials, in the end it represents a measure of the lifetime of a product, under certain given conditions. Durability is a temporal feature of the quality of a particular product. It is not without interest to point out that the recent STAS 2810/80 defines the concept of ″metrological durability″ in the following way: the quality of a measuring instrument to have a useful life under conditions of operation and maintenance in accordance with the specifications.

In the specialized literature in the Romanian language, there is a strong preference for the term ″life expectancy″ ″average life expectancy″ etc. In order not to be confused with the term durability frequently found in mechanics (especially the mechanics of breaking materials) in the sense of resistance to wear and/or physico-chemical changes under certain given conditions.

As already pointed out in the case of non-repairable items, durability is simply expressed as the time of operation until failure.

As it is not possible to study each object separately, in terms of its durability, the statistical concept of the average is inevitably invoked.

Thus, for a batch of light bulbs, for example, the average lifetimeexpresses the average durability of the product ″light bulb″ and is a characteristic associated with that batch.

For this reason, by durability control we will understand the control for the reception of batches of products where the quality characteristic taken into account is durability, ″quantified″ by the minimum average operating time, imposed for the batch considered.

Since it is therefore a reception control, the durability control can be part of the general quality control system carried out for the purpose of receiving batches of products.

However, durability control is a special type of acceptance control: regardless of the physical nature of the products of the batch (cutting tools, assembly parts, electronic tubes, etc.), the quality characteristic subject to verification is one and the same, namely the average duration of operation. Apart from this, regardless of the nature of the lot subject to control, the observation (experimental) data obtained after trying (testing) the objects in the sample will always be the durations of operation until failure of the tested elements. These experimental data are obtained in ascending order, a fact that required for their statistical processing the use of a rather sophisticated mathematical apparatus, called the "theory of order statistics".

The parameter taken into account in durability control is therefore time. The reception itself is carried out with the help of the so-called durability tests which, depending on certain considerations, usually economic, are carried out according to a well-established methodology. As can be seen, durability testing does not mean its control. If durability testing means deducing an average operating life (hence an estimation problem, from a statistical point of view), durability controlmeans verifying a statistical hypothesis on the theoretical average durability of the batch of products, a verification that ultimately leads to acceptance or rejection of that lot.

The purpose of any receiving control method is to provide a so-called ″control plan″ (perhaps it would be more correct to say ″quality check plan″) that includes:

1 - how many objects to be subjected to qualitative verification, regarding the characteristic studied

2 - a number (A) called acceptance

3 - the decision rule on the lot, which, in most cases, is the following:

- if d is the number of defectives detected in the sample subject to verification (sample of volume n), then:

a) if d is ≤ A, the lot is accepted;

b) if d >A, the batch is rejected.

Durability control conforms to a point to this general algorithm, but presents the following particularities:

1) the number of defectives detected in the sample is the number of objects that fell during the test period fixed by T0, so actually a control plan for durability is the triplet.

2) representing a statistical hypothesis on the theoretical average durability, i.e. basically the beneficiary wanting to reject with a high probability the lots that have an average durability lower than the durability considered acceptable, the choice of the control plan effectively depends on the statistical model that describes the durability as a random variable.

So here is the connection between durability testing and control: the types of testing provide the statistical model through special procedures for checking these models, generated by the incomplete samples that are obtained (types I and II), and in turn, these models, combined with the specific control methodology (imposing a test time in which falls are recorded) provides the durability control plan - the practical tool for carrying out this control.

In the set of methodologies intended to ensure an appropriate quality and reliability, the place of durability testing and control is presented (figure 1).

Durability control can be performed both by the manufacturer who delivers the batches of products, and by the beneficiary who purchases these batches.

From the point of view of the beneficiary, the durability control is also important due to the following fact: by carrying out a durability control, the beneficiary is obviously obliged to submit the respective sample to a durability test. But, before they are ″durable″, the respective products must fulfill the function for which they were created for some time, that is, work.

If those products work, it means that certain quality characteristics can meet the required specifications. So, together with the control of durability, there can also be a control of some quality characteristics that do not depend on time as a technical tolerance.

An important role in the control of durability - as in the reception control of products in general - is played by the economic control between the supplier and the beneficiary. The following elements must be provided in this contract:

1) the average duration of operation considered acceptable for the beneficiary (and which, of course, the manufacturer can ensure)

2) test time, T0

3) statistical distribution of durability

4) volume of delivered lots

5) sustainability control plan

6) technical conditions specific to the durability test.

These aspects require a wider comment since the success of the quality control system in general depends on its organization.

The average duration of operation is determined according to the real possibilities of the producer, as well as the requirements of the beneficiary.

A too long duration entered in the contract, if it cannot be ensured by the manufacturer, will inevitably lead to the rejection of various lots by the beneficiary.

For this reason, before concluding the contract, the beneficiary must carry out a preliminary analysis of the durability of the batches of products delivered by the supplier.

In this sense, an ″n out of n″ type experiment is the most appropriate, as it initially provides more complete information on durability. On this occasion, a realistic test time T0 can be established, taking into account the average actual operating time as well as the costs of testing.

The statistical distribution can be entered into the contract either directly, without a prior study, based only on the existing information, or taking into account the indications given in the specialized literature, or as a result of such a prior study, for which purpose, for the ease of synthesizing the data and working methods, the so-called ″type sheets″ for establishing the statistical model are proposed in this guide.

The good products contained in such a batch store in them costs that should not be wasted. For this purpose, the beneficiary and the producer will mutually agree on the "fate" of such lots.

So here are the multitude of aspects that appear in sustainability control. In addition to the statistical-mathematical apparatus, absolutely necessary to obtain an optimal decision, the so-called ″non-mathematical″ problems occupy an important place, the viability of the control system essentially depends on their solution.

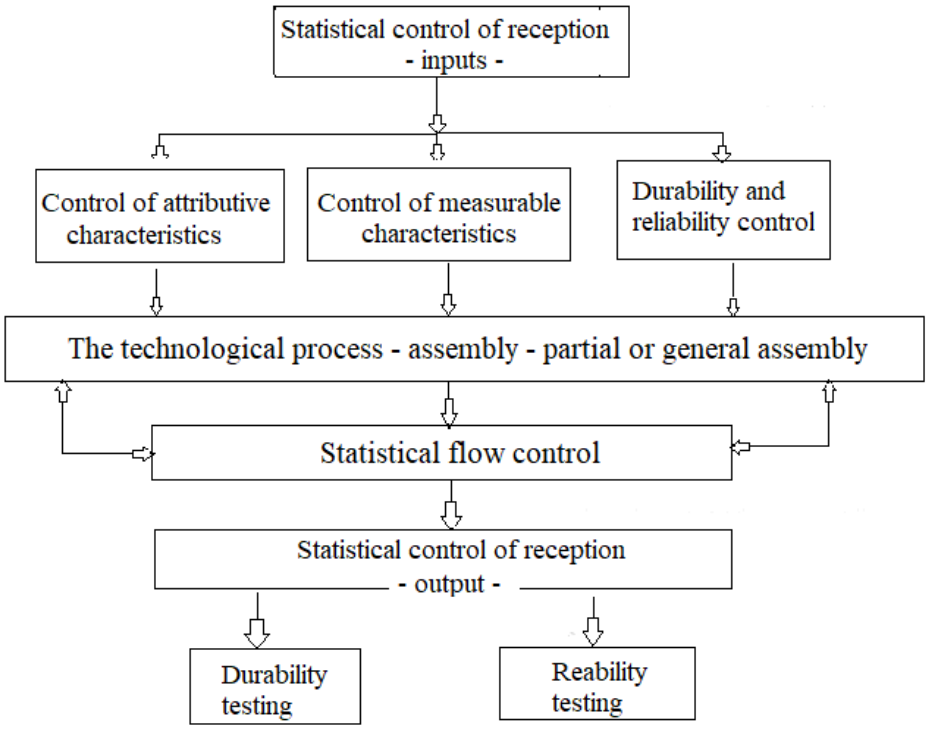

Fig. 1. The set of statistical methodologies used in statistical quality control

3. CONCLUSIONS

The proportion of non-conforming products (the so-called defectives) when the production is of large series and mass (so theoretically infinite) is the essential characteristic of this production, and the information on the respective proportion can only be obtained through statistical reasoning that makes the transition from the sample to the population. The volume of the delivered lots is established based on the statistical tables that accompany the control plans in each individual case, taking as the minimum volume the largest volume (n) of the sample to be controlled.

The technical conditions are established by mutual agreement, taking into account the destination of the respective products and the requirements of the beneficiary.

An important aspect that must be mentioned in an economic contract is that related to the destination of the rejected lots. As practice has long proven, a rejected batch does not only contain substandard products.

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