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STATISTICAL QUALITY CONTROL METHODS OF PRODUCTS AND SERVICES

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Abstract: *This paper aims to highlight an approach to quality management of statistical control methods carried out during production or finished products in the automotive industrial segment. Statistical quality control is a method commonly used in this industry. Control respecting estimators of distribution parameters for calculating limits. Quality products must comply with international safety standards after use.*
Key words: *SPC, quality, control, process*

1. INTRODUCTION

Quality assurance was achieved through statistical method during the 3-5 decades of the twentieth century. As a promoter Walter A. Shewhart (1851- 1967) introduced it in 1924 to the American Bell Telephone Laboratories).
Emphasis was on flow control technology, to identify causes of defects. Statistical control methods were used, i.e. sampling with sampling, leading to cost reduction control. Further research in statistical analysis consists of placing the cost on the number of defects in products, quality / cost statistically speaking;

2. STATISTICAL PROCESS CONTROL

SPC (Statistical Process Control) is a quality management method, using a process that can be monitored and if necessary intervention may be an adjustment to correct that process before the result nonconformities. If a complex technological process runs, statistical procedures help to identify systematic deviations early in the process, so that quality characteristics are maintained within the predetermined tolerance. Due to this property , statistical control processes and products are among the preventive methods of quality management (Fig.1).

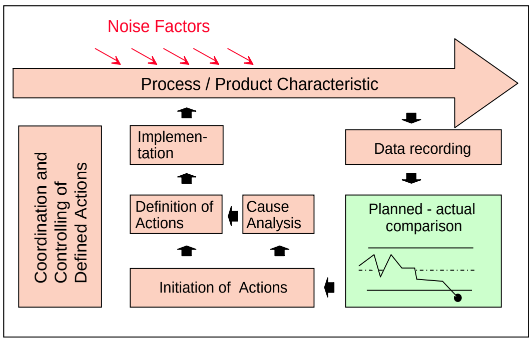

Fig.1. Statistical control

SPC is a way to control and improve production processes and products using continuous control loops and a method of prevention, measures are initiated before the tolerances to be violated. Statistically calculated control limits are used to indicate a change in the status report before being accepted. To implement this method, samples of the process or product should be taken and observed values should be compared with control limits. These limits allow one to observe or to distinguish if such deviations are random or systematic. Only in the case of systematic deviations documented actions shall be triggered. Estimators of parameters of the distribution function (i.e. mean and standard deviation), control limits are based on random dispersal range (i.e. $\pm 3\sigma \equiv 99{,}73$ %) (Fig. 2).[2]

Test results of samples are displayed in chronological order. If the value is within the estimated range, the process is under statistical control and no action should be started. Measurement systems used for research capability and PPS should be qualified by a Measurement Systems Analysis(MSA).

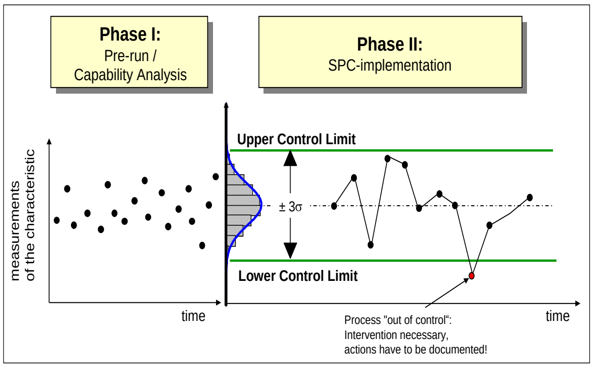

Fig. 2 Parameter estimators

2.1 Conditions to achieve statistical control

General sequence of phases completed to achieve statistical control of processes and products is:

- Planned checking of survey samples. At this stage in the set of parameters that characterize a product or process, characteristics are chosen to be pursued;
- Accidental sampling survey of an uncertain group is done according to a random or planned procedure.
- checking of each copy of accidental sample survey;
- statistical evaluation of data determined by calculating the statistical parameters and filling up cards;[3]

2.2 Sample size

Taking samples, of components, provides a better detection rate for changes in process, but time and costs must be considered also. However, the knowledge on the performance parameters of the preliminary analysis of process capability should be used. The bellow table may be used to determine the sample size. The sample size should be adjusted for the serial production as an effect of the performance process (Cp, CPK, PP, PPK), using the same table.

C_p	...≤ 1.33	1.33<. ≤1.67	1.67<... ≤ 2	...> 2
n	10	8	5	3

Tab. 1. Sample size table

For conferring diagrams the following formula to determine sample size should be used:

$$n \geq \frac{1}{p} \quad (1)$$

$\bar{p}$: means failure rate

3. FREQUENCY

There are no standardized terms to define the frequency. The following checkpoints should help to find frequency:

- the experience of using similar processes;
- without experience of similar processes; it starts with two pieces per shift, one of the samples should be taken at the beginning of a shift;
- while operating the equipment (1 * 8 hr / 2 * 8 h / 3 * 8h);
- natural tendency of the process if it exists;
- with delayed reaction (to take into account between failure detection and delivery);
- level of significance of the parameter;
- maximum capacity to process or be retested;
- during the use of frequency of the SPC- types should be dynamically adjusted according to process capability;[4]

3.1 Preliminary calculation of control limits

The process capability target for the PCA and, therefore, pre-election also is CPK> 1.33. If we consider the lower limit (CPK = 1.33), median distance from the nearest process (critical), the specification limit is exactly four times the standard deviation. For the median of the process it means that information from pPCA may be used. This chart is an acceptance control chart. It is possible to calculate the standard deviation and that is hypothetical long-term capability. UCL and LCL control limits of Shewhart-chart parameters are calculated at 99% or 99.73, random interval dispersion using the corresponding distribution parameters. Limit formula depends on the distribution function and sample size.[5]

4. ACCEPTANCE GRAPHICS

Control limits of acceptance-chart are calculated from the specified limits USL and LSL and dispersion according to the bellow figure (Fig. 3). The distribution means determine the probability of acceptance, i.e. the probability that the measured value is within control. Based on these probabilities defined, K-factor is multiplied with of the standard deviation.

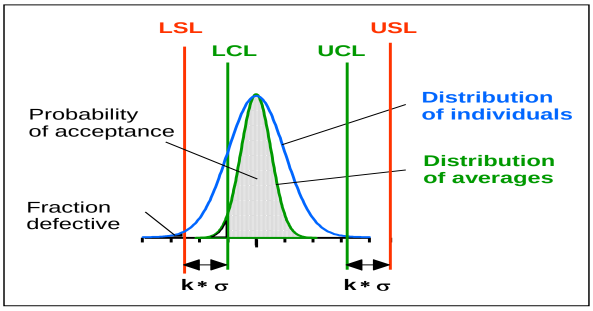

Fig. 3. Graphic acceptance

K-factor depends on the type of chart, distribution function, process capability, the sample size. Examples SPC charts and special situations to watch.

In this example, the two values differ significantly from the others, even if the values of tolerance between these parts are candidates for potential failures.

4.1 Process optimization methods

Typically, the optimization of a process targets, first of all, to ammend the process' position and the width interval dispersion. Steps that must be followed:

a. to identify the systematic influence;
b. process analysis;
c. Root cause analysis - using only information from the control card, one can not deduct any explanation on the causes of failure or a very large dispersion. Therefore, to determine causes of failure it is necessary to use different methods, such as accompanying document analysis process, Pareto analysis, brainstorming, FMEA, cause and effect diagram (Ishikawa or fishbone diagram).[6]
d. To correct systematic influences;
e. to avoid the recurrence of systematic influences

5. CONCLUSIONS

The basic principle of the method is to identify errors, but to avoid them. PPS contributes to reducing costs because of scrap, further processing and verification costs.

When using PPS, its positive influence on the process in terms of quality is noted. Using PPS allows savings by reducing tool change frequency, a diminuishing of the number of interventions in reducing losses generated by process or control operations.

The benefits that can be obtained by using PPS method are:

- The avoidance of errors in production;
- The reduction in ultimate control verification measures;
- The detection and removal of harmful quantities of a process both in terms of their magnitude and in terms of optimizing parameters affecting the process, such as song material and tolerances, machine specifications, adjustment tool or means of verification specifications;
- The increase in overall productivity growth and therefore the systematic use of tests and their documentation, evaluating long-term forecasts through a continuous process of feedback applied to measurement data.

6. ACKNOWLEDGEMENT

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