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Statistical quality assurance of vehicles

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Abstract

The method of the computerized assessment of vehicles, their materials and equipment was developed, calculation and visualization of statistical quality and quality control was prepared by the application of computer packages. The list for the implementation of quality processes was established. Quality control graphs were analyzed. The method of statistical average was applied and computerized calculations were carried out.

Key words: statistical quality control, reliability, visualization

Introduction

One of the primary production levels of quality management techniques is the quality control system covering the entrance of the materials and details of control, interim control, various stages of production, finished products and drain control. The Manufacture of sophisticated electronic devices, the importance of the control system are relatively high both in terms of cost and impact on the final result. The control system can be changed quite significantly, and it can cause the release level of production quality, and cost [2].

Statistical control and quality management

To ensure the reliability of the product statistical quality control quality the management is used. Therefore, the company must implement the following processes:

- Participate in the design, statistical quality control and quality management and planning;
- To develop technology of participation, statistical quality control and quality management and planning;
- To select the control of the use of the product stage;
- To select control methods of training the staff;
- To observe technological processes of the statistical methods producing the product and its components;
- To follow technological processes of the statistical methods for adoption, staff training;
- To carry out control quality in the manufacture of the product;
- To look after stability control, in particular after the important product of the technological process control, and the regulation of specific processes;
- To analize the data of the technological process in order to identify the developments;
- Stability control and process control in personnel training;
- To use corrective action, when the process goes beyond the permitted limits;
- To execute additional control of the application of the corrective actions;
- To estimate the supplied production (raw materials, semi-finished products) providing with the statistical quality control assessment.
- Fulfilment of the mentioned items guarantees quality products [6].

Controlled and uncontrolled processes

For the application of the statistical quality control it is important to know whether the process is controlled, since it belongs to the subject of statistical control. So this is a controlled process, the process by which the observed values are set within the set limits. Of course, when the process goes beyond the limits of significance, it may not necessarily be out of control, as it ruins the assumption guess that the observed data are random, so it is important to analyze the following reason [1].

Quality control charts are set up:

1. The points representing the curve is a measure of the quality characteristics, which are taken from the production processes at different time instants (data);
2. The middle line is drawn, the process characteristics estimates the average, which is found from the data;
3. The upper and lower control limits, which refer to the controlled process limits [8].

Sample graphs and the average utilization of the quality control

Sample graphs and the average method are obtained in the following steps:

1. Choose rational subgroups of data. From each production batch, select the appropriate number of products tested and the number when they are collected at equal time intervals;
2. Establish a sample schedule (R-chart);
3. Identify each point, which is outside the control limits, its cause. If this is caused by the process of technological change or other factors that cause deviation of the process of distorting the reference method may continue to point 4.

4. Recalculate a sample schedule, excluding non-points;
5. Upon receipt of the control process of the sample graph, calculate the average of the schedule (chart), the dismissal of uncontrolled sample schedule of the members;
6. If the average shows that the process is uncontrolled, it means that the production is of a poor quality.
7. Continues and the average of the sample graphs of monitoring data by adding a new production [3].

Sample graphs of the average method are given in Fig.1 and 2:

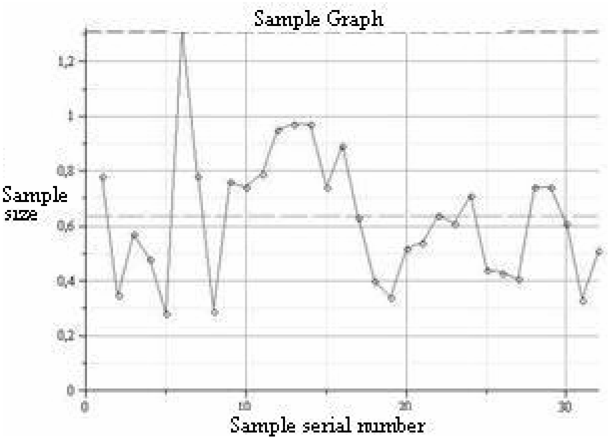

Fig. 1. **Sample schedule (R-chart). 6 is controlled by the limits**

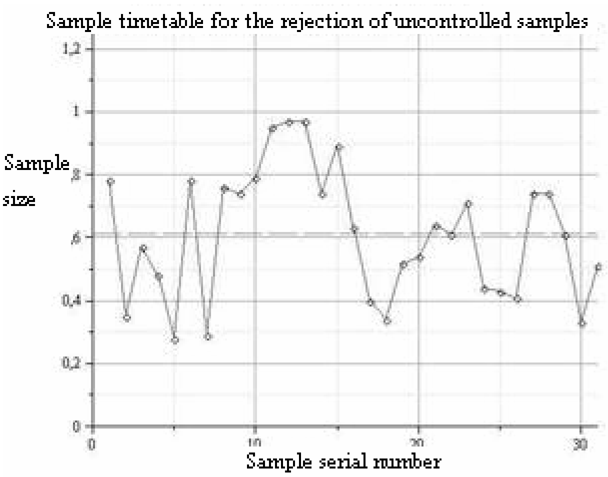

Fig. 2. **Sample timetable for the rejection of uncontrolled members**

The production process is controlled, so we can continue the approach given below:

$$\overline{R} = \frac{\sum R_i}{n}, \tag{1}$$

where $\overline{R}$ is the sample sizes the absolute difference in average; R_i - i-th sample of the absolute difference,

$$R_{up} = \overline{R} + 3\overline{\sigma}. \tag{2}$$

R_{up} is the upper limit; $\overline{\sigma}$ is the average of the standard sample deviations,

$$R_{down} = \overline{R} - 3\overline{\sigma}, \tag{3}$$

where R_{down} is the lower incision,

$$\overline{\sigma} = \frac{\sum \sigma_i}{n}, \tag{4}$$

where σ_i is i-th sample standard deviation.

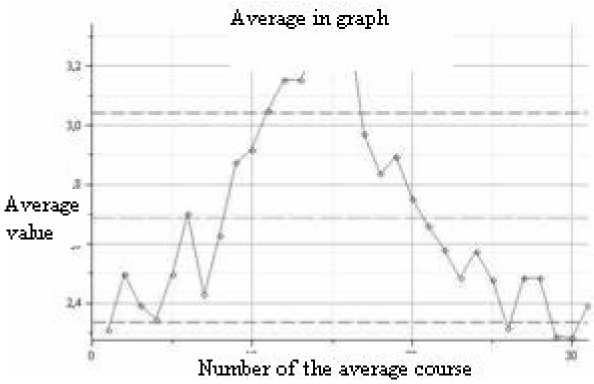

Fig. 3. **The average schedule**

From Eq. 5, 6, 7, 8 the average schedule formulas are obtained (Fig. 3):

$$\overline{\overline{X}} = \frac{\sum \overline{X}_i}{n}, \tag{5}$$

where $\overline{\overline{X}}$ is the average rating; $\overline{X}_i$ is the i- the mean,

$$\overline{\overline{X}}_{up} = \overline{\overline{X}} + A_2\overline{R} \tag{6}$$

Where $\overline{\overline{X}}_{up}$ is the averages of the top notch; A_2 is the deduced rate averages,

$$\overline{\overline{X}}_{down} = \overline{\overline{X}} - A_2\overline{R} \tag{7}$$

where $\overline{\overline{X}}_{down}$ is the average of the lower incision,

$$A_2 = \frac{3\sigma_{\overline{X}}}{\overline{R}}, \tag{8}$$

where $\sigma_{\overline{X}}$ is the averages of the mean square deviation.

The a sample of the graphs and the average method is used, to determine whether the manufacturing process meets the quality requirements. It is noted that the graphs by which we define the process auditability and decide about the production quality, can not determine the reason why this occurs. It is therefore important to understand the technology and manufacturing process and collaborating with specialists of various fields the deviation is corrected and the desired quality is achieved [3].

This is especially true for various production processes in which automation is used, therefore it is important to use modern technology. Virtual planning of experiments and mathematical modelling is the only way [4].

The method of realization

The method was realized in the mathematical package Maple aid. The comparison was made with Microsoft Excel, Matlab and Statistica packages, tools, applicable to the statistical challenges [5].

Comparative tests showed that the Maple package of aid is easier automated solving this type of a problem. In other words, the Maple package universality is obvious, but it requires more mathematical statistics, and programming skills.

Table 1. **Production process monitoring**

Details								
Sample no.	Sample values					Average $(\overline{X})$	Sample Size (R)	Dispersion (σ)
1	2,53	2,66	1,88	2,21	2,26	2,308	0,78	0,303
2	2,69	2,38	2,34	2,47	2,61	2,498	0,35	0,149
3	2,67	2,23	2,1	2,43	2,54	2,394	0,57	0,23
4	2,1	2,26	2,51	2,58	2,28	2,346	0,48	0,196
5	2,64	2,42	2,56	2,51	2,36	2,498	0,28	0,111
6	2,64	1,63	2,95	2,12	2,67	2,402	1,32	0,525
7	2,58	2,69	3,01	3,01	2,23	2,704	0,78	0,327
8	2,31	2,39	2,6	2,4	2,46	2,432	0,29	0,108
9	3,03	2,68	2,27	2,54	2,63	2,63	0,76	0,274
10	2,86	3,22	2,72	3,09	2,48	2,874	0,74	0,294
11	2,71	2,8	3,09	2,6	3,39	2,918	0,79	0,32
12	2,95	3,54	2,59	3,31	2,87	3,052	0,95	0,375
13	3,14	2,84	3,77	2,8	3,22	3,154	0,97	0,39
14	2,85	3,29	3,25	3,35	3,59	3,266	0,74	0,267
15	2,82	3,71	3,36	2,95	3,37	3,242	0,89	0,358
16	3,17	3,07	3,14	3,63	3,7	3,342	0,63	0,298
17	2,81	3,21	2,95	3,04	2,85	2,972	0,4	0,16
18	2,99	2,65	2,79	2,8	2,95	2,836	0,34	0,137
19	3,11	2,74	2,59	3,01	3,03	2,896	0,52	0,221
20	2,83	2,74	3,03	2,68	2,49	2,754	0,54	0,198
21	2,76	2,85	2,59	2,23	2,87	2,66	0,64	0,265
22	2,54	2,63	2,32	2,48	2,93	2,58	0,61	0,226
23	2,27	2,54	2,82	2,11	2,69	2,486	0,71	0,293
24	2,4	2,62	2,84	2,5	2,51	2,574	0,44	0,168
25	2,41	2,72	2,29	2,35	2,63	2,48	0,43	0,186
26	2,4	2,33	2,4	2,02	2,43	2,316	0,41	0,169
27	2,56	2,47	2,11	2,43	2,85	2,484	0,74	0,266
28	2,21	2,61	2,59	2,24	2,34	2,398	0,4	0,191
29	2,56	2,26	1,95	2,26	2,4	2,286	0,61	0,225
30	2,42	2,37	2,13	2,09	2,41	2,284	0,33	0,161
31	2,62	2,11	2,47	2,27	2,49	2,392	0,51	0,201
32	2,21	2,15	2,18	2,59	2,61	2,348	0,46	0,231
						$\overline{\overline{X}}$ =2,678	$\overline{R}$ =0,633	$\overline{\sigma}$ =0,225

Conclusions

1. The method was developed, which can be used to ensure vehicle quality and reliability.

2. Automation of calculations was carried out by using the mathematical package Maple12. The data were obtained and analyzed in visualization graphs.

3. The method was adapted to the manufacturing process in order to determine the quality of the products according to the statistical data.

4. Next goal is to create an automated program, which would analyze the production process control and reliability.

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Statistinis transporto priemonių kokybės patikrinimas

Reziumė

Parengtas kompiuterinis transporto priemonių, jų medžiagų ir įrenginių kokybės įvertinimo metodas. Statistiniam kokybės ir kontrolės valdymo skaičiavimui ir vizualizavimui pritaikyti kompiuteriniai paketai. Nustatytas sąrašas kokybės procesams įgyvendinti. Analizuojami kokybės kontrolės grafikai. Pritaikytas statistinis vidurkio metodas ir atlikti kompiuteriniai skaičiavimai.

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