THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICHAL ENGINEERING, ISSN 1224-5615
2019

# QUALITY MANAGEMENT TOOLS

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## ABSTRACT

*Quality management is the process of identifying and managing the activities necessary to achieve the quality objectives of an organization. Implementing quality management involves all members of the organization. Thus, the management of the company becomes the responsibility of all levels of management, but it must be managed from the highest level. The paper presents the traditional quality management tools, used to solve the quality problems.*

KEYWORDS: quality management, total quality, quality control, quality tools

## 1. INTRODUCTION

The methodological tools used in the quality management are used to collect information (data) on quality, for their processing, interpretation and using. Thus, these tools are used both in the quality control and in the analysis, evaluation, quality improvement of:

- identification of the quality problems;
- problems defining;
- identification of the causes of defects;
- analysis of the possible causes;
- checking the main causes;
- prioritization of the actions for improvement;
- establishing the place where to intervene;
- application of the action plan;
- action checking.

These tools are an integral part of the quality information system. Today there are many such tools, some already considered classic and others newer. From the group of classical, traditional tools, used to continuously solve the quality, based on statistical and graphic principles, we mention:

1. Charts;
2. “Cause and effect” diagram;
3. Statistical control;
4. Pareto diagram;
5. Correlation diagram;
6. Benchmarking;
7. Brainstorming.

More recently (1988), new methods (Mizuno) have been introduced, such as:

1. Relationship diagram method;
2. KJ (Kawakita Jiro) Method;
3. Systematic diagram method (tree chart);
4. Matrix diagram method;
5. Matrix method for data analysis;
6. PDPC method;
7. Arrow chart method.

The new methods, mentioned above, do not replace the traditional methods, but only supplement them.

## 2. CHARTS

The chart is the way to more easily understand a certain process.

Chart types:

a) column;
b) line;
c) pie;
d) bar;
e) tree.

The charts are a good tool for the managing and improving workplace activity and have the following advantages:

- make the information easier to remember;
- help to identify trends and other process characteristics;
- may highlight facts and relationships that were not foreseen.

*The column chart* is drawn up in order to perform the comparative analysis of some characteristics either in time or compared to other similar units.

Figure 1 shows the graph of the origin of the parts (indigenous and imported) used in the

robots manufacturing. The analysis was performed over three years and it highlighted the reduction of the share of imported parts.

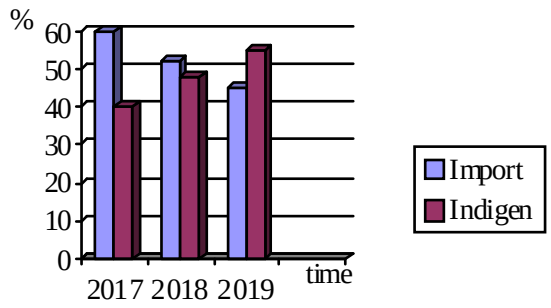



Fig.1 Origin of robots parts

*The line chart* is used to analyze changes of a product quality characteristic in relation to certain parameters or changes over time of an economic parameter (sales, receipts, profit). Figure 2 shows the variation of a company profit.

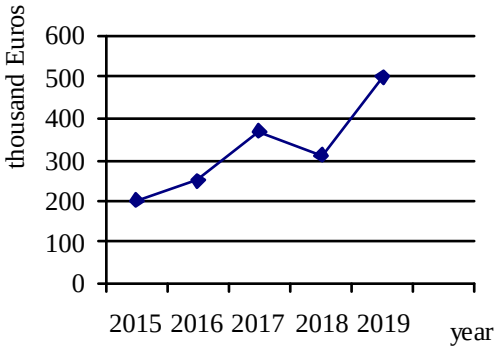



Fig.2 The company profit

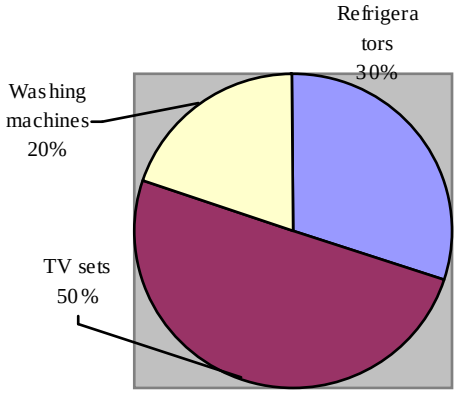



Fig.3 Sale of household appliances

*The pie chart* is recommended when looking at the proportions of some components of a product, process.

Figure 3 shows a pie chart which establishes the proportions of the sale of house appliances in a specialized store, for one year.

*The belt chart* is similar to the pie chart because it presents in percentage or in absolute values different aspects of production, control, administration, etc. In figure 4 the belt chart presents the percentage of a batch of parts controlled for a month

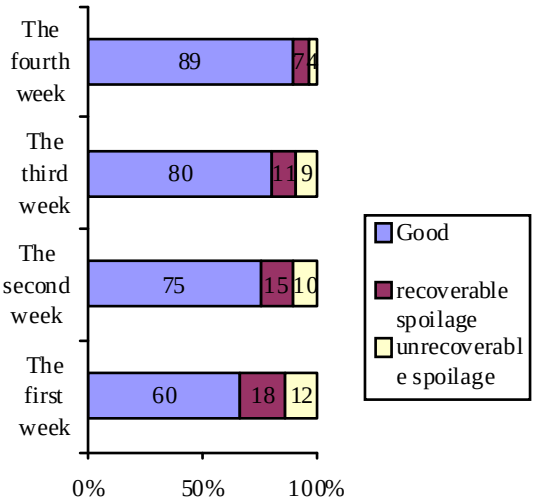



Fig. 4 Percentage of the spoilages after processing

*The tree chart* is drawn up for the analysis of the causes that lead to the appearance of an effect and for the identification of the factors that influence the objective. The advantage of using such a graph is the possibility to examine in a logical and chronological sense the causes of the defect. Basically, the chart is drawn as in figure 5. First the objective is established, and then the "tree" is built by specifying the objectives and actions necessary to achieve them. An example of such a chart is shown in figure 6.

## 3."CAUSE AND EFFECT" DIAGRAM (ISHIKAWA DIAGRAM)

This tool is also known as the "fishbone" diagram. It is used to establish the relationship between the effect and the causes to which it is related. The diagram classifies the various causes, which are believed to affect the results of the work, marking with arrows the cause and effect relationship between them. Figure 7 shows the basic structure of the cause and effect diagram.

It is recommended that a team that has previously organized a brainstorming session to participate in this chart. In this way, only the causes that caused the effect can be selected.

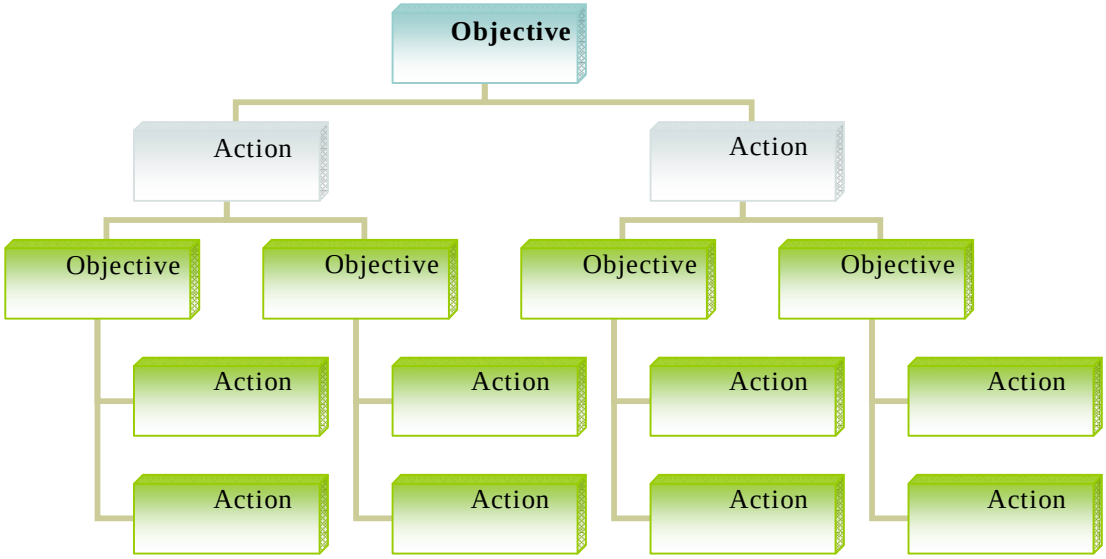



Fig.5. The tree chart

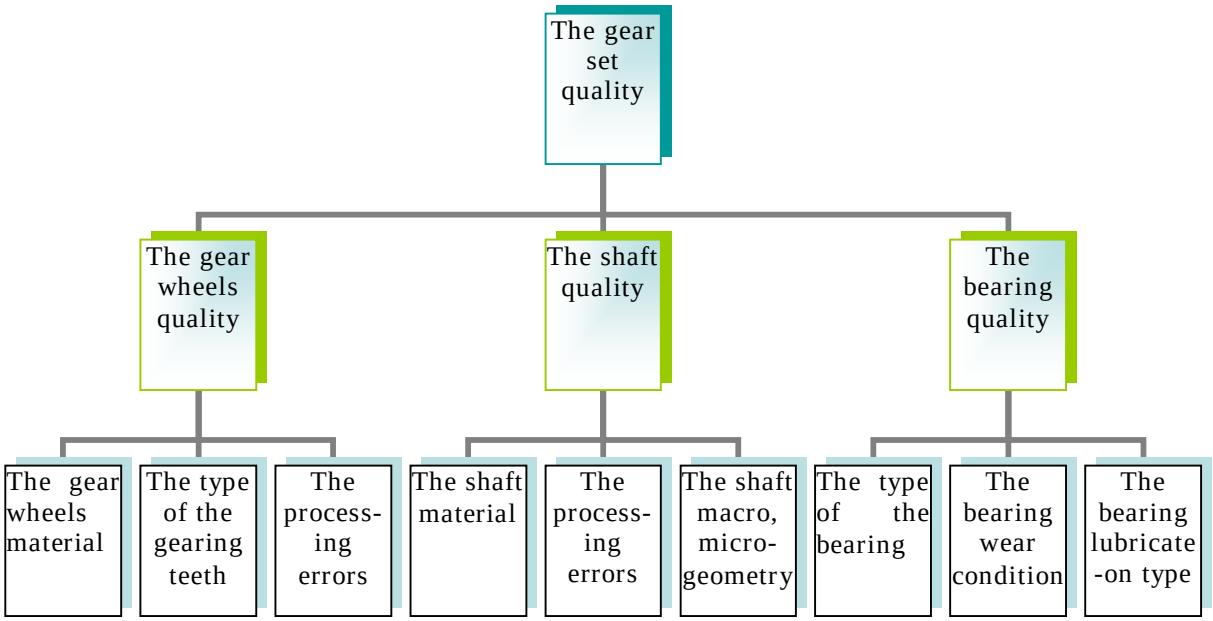



Fig. 6 Tree chart to improve the quality of a gear set

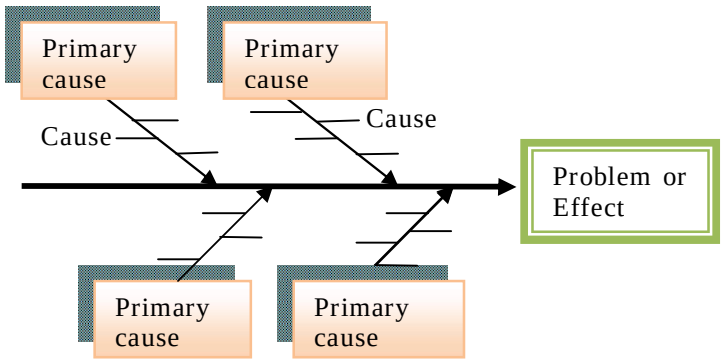



Fig. 7 Cause and effect diagram

The Ishikawa diagram has two parts: a part of the causes and a part of the effect (figure 7). the effects are defined by quality the characteristics or work problems, costs, quantity of production, delivery, job security, quality circle activities.

Following the elaboration of the diagram, the priorities for solving the causes will be established, followed by measures for their elimination. it is very important to monitor the application of the measures and then check the influences on the effect.

## 4. STATISTICAL QUALITY CONTROL

Statistical control can be performed in three variants, depending on the field of use, as follows:

a) statistical control based on defects, specific to the light industry;

b) statistical control based on attributes, specific to the metallurgical industry;

c) statistical control based on measurements, specific to the construction of machines.

In the construction of machines, the control based on measurements can be performed:

- after processing the batch of parts;
- during the processing of the batch of parts;
- upon receipt of a batch of parts.

### 4.1 Statistical control after processing the batch of parts

After measuring the parts and ordering the obtained values , the histogram or frequency polygon can be drawn.

The term *histogram* comes from the Greek words *histos* (tissue), *gramma* (drawing) and is a particular form of diagram that uses rectangles for the graphical representation of a phenomenon, a correlation between two or more sizes.

Histograms are used, in particular, in mathematical statistics, for the graphical representation of a distribution, of the dispersion of some analyzed values, by rectangles, so that the height of each rectangle is proportional to the represented value.

The useing of histograms is very effective in the quality improvement activities, in the activity of quality circles, when the aim is to eliminate defects and improve quality. In these activities, histograms are used to:

- checking the satisfaction of the specifications (tolerant), deepening the existing relations between the product and the specifications;
- the orientation of the activity towards the critical and main defects, towards the categories of defects whose cumulative number has a tendency to increase;
- examination of the causes that determine variations in the manufacturing process, by separating the causes: materials, machines or equipment;
- comparison of two cases corresponding to a quality improvement process.

The histograms are drawn up according to a certain algorithm:

1. Preparation of the data table;
2. Drawing up the frequency table, which outlines the histogram;
3. Drawing the histogram (Fig.8).

## 5. PARETO CHART

The Pareto chart is formed in columns which, in height, represent the number of defects. The columns are drawn in descending order of size (Fig.9). To draw up this diagram, follow the steps:

• establishing in time the data collection periods, the method used and their classification according to the causes;

• ordering the data according to the frequency of occurrence;

• the causes or defects are written on the horizontal axis of the rectangular coordinate system, and their number is written on the vertical axis;

• tracing the columns with the reported defects (causes), in descending order of values (A, B, C,…G). The last column is for "other defects"-G;

• from the end point of the curve with the cumulative number of defects, representing 100%, draw the parallel to the vertical axis that overlaps with the column "other defects". In this way the scale for the cumulative percentage can be established;

• the name of the diagram, the period in which the data were collected, the place, how it was performed, etc. are specified.

It is recommended that the Pareto chart be used when the types of defects and their causes are known, so that interventions can be effective.

Using the Pareto diagram, it was found that:

• 20% of causes lead to 80% of defects;

• 80% of the turnover is made by 20% of the clients;

• 80% of absences from work are caused by 20% of employees;

• 80% of non-quality costs are due to 20% of defects.

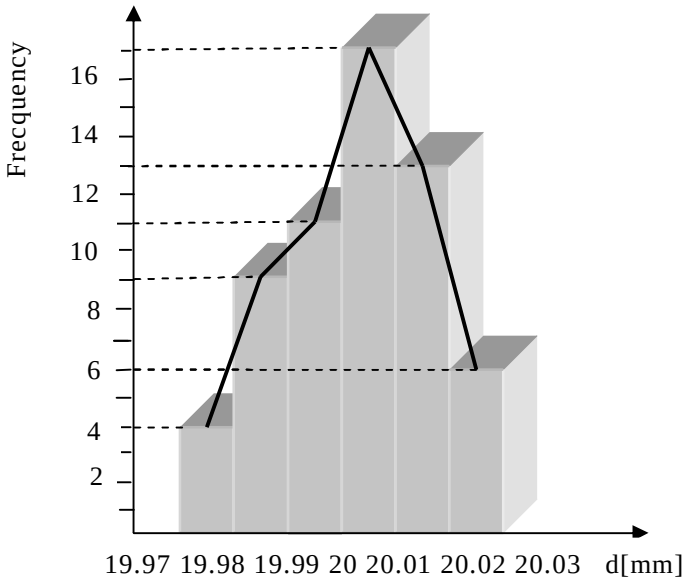



Fig.8 Absolute frequency histogram

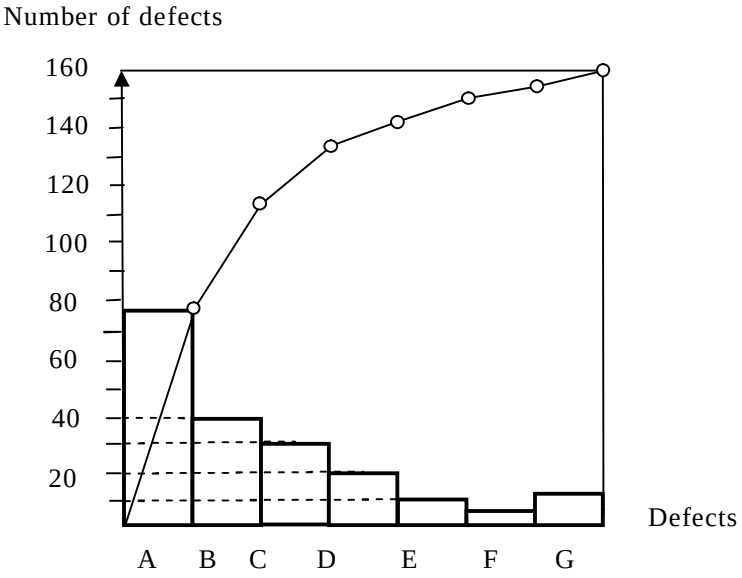
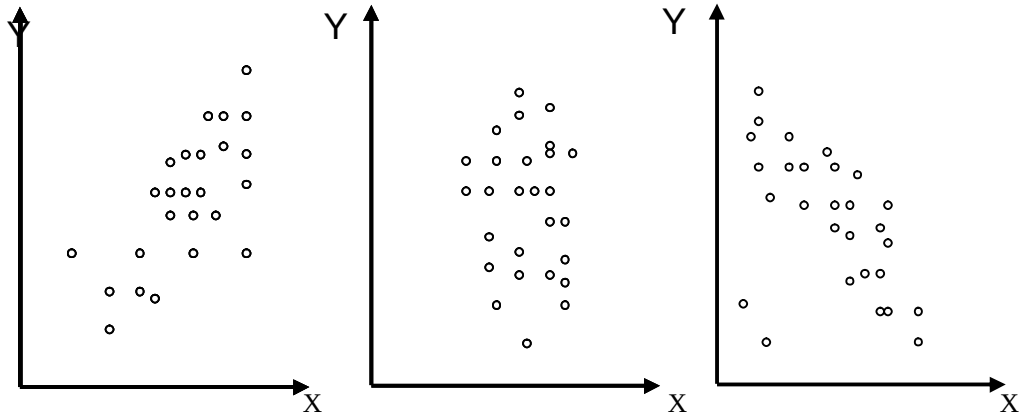



Fig.9 PARETO chart for defects of a processed batch




a) positive correlation b) non-correlation c) negative correlation

Fig.10 Correlation diagram

## 6. CORRELATION DIAGRAM

The correlation diagram aims to analyze the relationship between two characteristic variables or processes. In the graph that is drawn up, the variables or characteristics (x, y) to be analyzed are entered in the rectangular coordinate system. The variables can be in positive, negative correlation or in non-correlation (Fig.10).

The following conditions must be met to draw the correlation diagram:

- there are sufficient properly grouped data (between 30 and 50 characteristic data pairs);
- the settings chosen for the two variables should be as close as possible;
- the diagram shows the correlation period, the objective, the product name, the work process, the date.

The analysis using the correlation diagram can be useful in the following cases:

• for the selection, from the factors that affect it, of those with a strong influence on the quality characteristic;

• to determine the optimal rank of the variable, in order to establish the conditions of the control characteristic;

• to compare the results obtained by simple and precise measurements, by destructive and non-destructive tests and to select the appropriate characteristics and methods for carrying out measurements and experiments.

## 7. BRAINSTORMING

This modern method was introduced by the american professor Alexander Osborn.

Brainstorming is an effective way for a team to generate ideas together.

The method was introduced in 1948, but the methodology of presenting ideas in groups is much older. In fact, brainstorming is a creative deliberation in order to generate ideas that will be used to solve problems.

In order to get positive results, in a team brainstorming session, the following rules must be followed:

a) to have a leader;

b) the leader must

encourage ideas, regardless of his opinion;

c) not to stop issuing interesting ideas;

d) to train all team members;

e) not to try to justify the ideas issued;

f) to write down all the ideas in the order of their issuance.

Various obstacles may arise during the brainstorming session:

- of a psychological nature: shyness, fear of ridicule, underestimation of possibilities, fear of not upsetting others;
- the nature of the subordination: the presence of a boss, the fear of losing his job, the severity of the boss.

All of these obstacles need to be removed in order for the meeting to be successful.

After the "stormy" meeting of ideas, it is recommended to calm down and then carefully analyze them, ie:

• eliminating "curious" ideas;

• grouping similar ideas and those that are in the field of the same criteria;

• filling in the gaps found;

•benchmarking;

•convening, if necessary, a new brainstorming session on the same topic.

## 8. CONCLUSIONS

The paper presents the traditional tools of quality management, used to solve quality problems at all levels of management.

With the help of these statistical tools, the unfavorable situations that determine reactions for their correction are highlighted:

- The charts are a good tool for the managing and improving workplace activity;
- Ishikawa diagram classifies the various causes, which are believed to affect the results of the work, marking with arrows the cause and effect relationship between them;
- The using of histograms is very effective in the quality improvement activities, in the activity of quality circles, when the aim is to eliminate defects and improve quality;
- It is recommended that the Pareto chart be used when the types of defects and their causes are known, so that interventions can be effective;
- The correlation diagram aims to analyze the relationship between two characteristic variables or processes;
- Brainstorming is a creative deliberation in order to generate ideas that will be used to solve problems.

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