

## **Theme: Tools of Quality Control**

**Goal:** Development of skills in the analysis of the sources of problems with a view to the correct and timely employee motivation, conflict resolution and efficiency of employees.

Resume writing skills with the requirements of the job and the personal characteristics of the candidate.

### **General statements**

Simple quality control tools are used to analyze quantitative data on the quality. They allow simple enough, but at the same time, evidence-based methods to solve 95% of the problems of analysis and quality management in different areas. They use methods of mathematical statistics and they are available to all participants in the process of production and are used in almost all stages of the product life cycle.

However, in creating a new product not all the facts are of numerical nature. There are factors that tend themselves to a verbal description. Consideration of these factors is approximately 5% of the problems in the field of quality. These problems are mainly in the field of process control systems, teams, and solving them; along with statistical methods one should use the results of the operational analysis, optimization theory, psychology, etc.

Therefore JUSE (Union of Japanese Scientists and Engineers) worked out a very powerful and useful set of tools based on the science; they allow making easy the task of quality management in analyzing these facts.

These tools are called «Seven Tools of Management», or «Seven New Tools of Quality Control ».

«Seven New Tools of Quality Control» include:

1. Affinity diagram;
2. Relations diagram;
3. Tree (system ) diagram;
4. Matrix diagram or quality table;
5. Arrow diagram;
6. Planning diagram – PDPC;
7. Priority matrix

The scope of application of «Seven Tools of Management», quality control is quickly expended. These methods are applied in the field of quality assurance in the field of office management and administration in the field of education and training in the field of performance monitoring, etc.

In the area of quality assurance application of the seven new tools most effectively at the stage of product development and project preparation for the development of measures aimed at reducing the marriage and the reduction of claims; to improve the reliability and security, to ensure the release of products without pollution, to ensure the objectivity of the inspection control, to improve standardization, etc.

# 1. BASIC INFORMATION OF SEVEN NEW TOOLS OF QUALITY CONTROL

## 1. Affinity diagram (AD)

Affinity diagram is used for the classification of ideas (causes, indicators, impacts, problems, conditions, cycle, etc.) into groups, united by a common character, the nature of these ideas. This classification helps to improve the use of existing ideas and finding new ones. Figure 1 shows an example of an affinity for the performance of the company.



Fig. 1 – Affinity diagram

Affinity diagram is built on the basis of "brainstorming" or analysis of any problem. Construction of a diagram affinity produces usually presented in sequence: make a list of ideas; write them down on self-adhesive sheets, leaflets attached to a board or a large sheet of paper, available for review to all members of the team;

Systematize ideas (sheets) with a common focus, in groups. This work is done without debate. Perhaps preforming group names; if there is a similarity between some groups, you can combine them into one big group. At this stage in the course of the general debate of the groups agreed, some ideas are reformulated, unite or differentiate.

## 2. Relations diagram (RD)

The diagram is intended to rank relationships related factors (conditions, causes, indicators, etc.) on the strength of the connection between them. Cause-effect diagram (CED) allows pointing out factors, impact on the process parameter, affinity diagram (AD) gives the possibility to group them due to criteria of the

inner generality. Relations diagram is a tool of depicting priority factors inside every group.

Conclusions are made on the base of the expert assessment within the “brainstorming”. Figure 2 presents the diagram of cause effect relations, depicted analysis of cause of high accidents at the work.

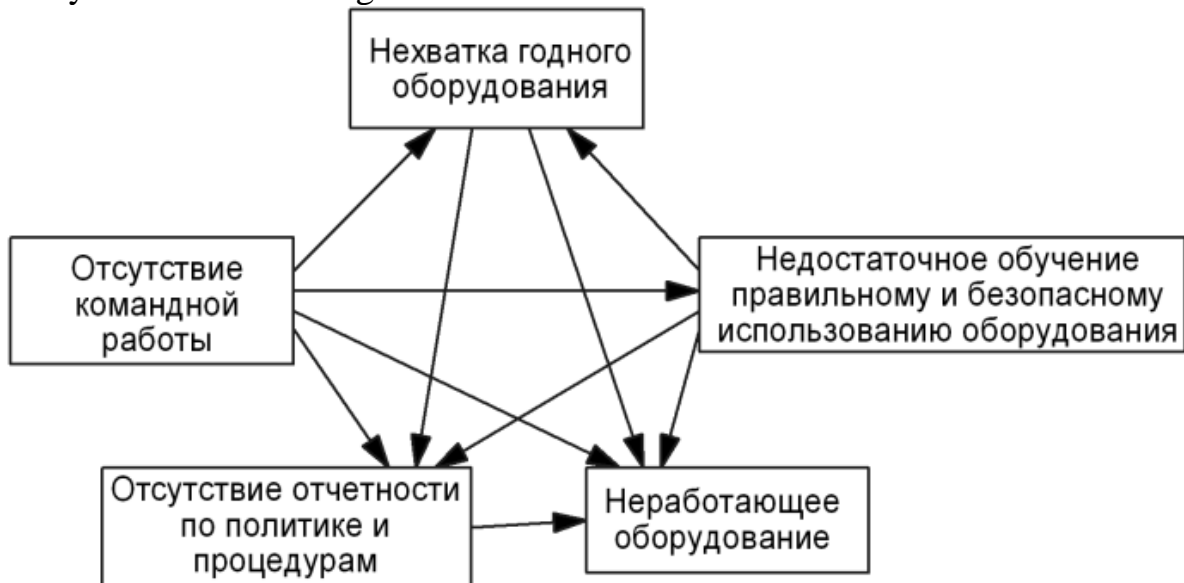


Fig.2 – Relations diagram

One can recommend the following way of creating the diagram.

1. Write down each problem on a separate sheet and attach the self-adhesive sheets in a circle on a poster;
2. Start with the top sheet and moving clockwise, ask: "Is there between these two events the connection?" If there is, then ask, "What event does cause another, or is the cause of another event?"
3. Draw an arrow between the two events, showing the direction of influence; After identifying the relationships between all the events, calculate the number of arrows emanating from each and every event is included in.

The event with the largest number of outgoing arrows is starting. The team usually selects two or three initial events that should be discussed, to decide which of them should be focused first. This takes into account a variety of factors, such as existing restrictions organization, resources and experience.

Figure 2 presents the main causes of high injuries, according to experts, the lack of team work and the lack of proper training and safe use of the equipment are causes of it. If between the studied factors can calculate the correlation coefficients, the relationship diagram can be supplemented with integrated force calculation to quantify the role of each factor in the system. It increases the confidence in the solution.

### 3. Tree diagram (TD)

After determining the relationship with the charts of the most important issues, characteristics in a tree diagram are looking for methods to address these problems and ensuring product characteristics, etc.

In finding core causes of the appearing problem the method «why – why» is used. The team members, which is addressing the problem, ask the question: "Why is it originated?" and receive a list of reasons for the first level. Then the question "Why?" address each cause of the first level and get the list of causes of the second level, etc. The relationship between the problem (characteristic, etc.) and its causes of different levels (methods and supply methods, etc.) is portrayed as a multi-tree structure. The figure3 presents the scheme of this diagram.

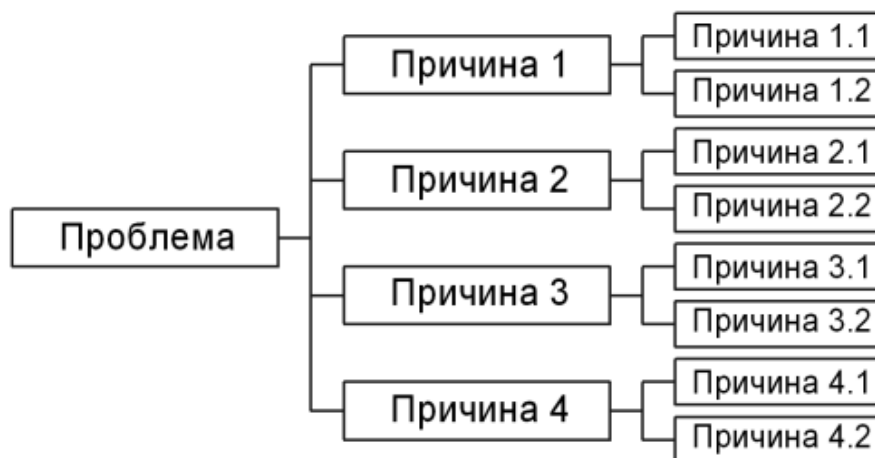


Fig. 3 – Tree diagram

While searching for the causes of any problem questions "Why" can be set for a long time and have either infinite list of reasons, either to withdraw the major underlying causes, the removal of which will effectively solve the problem. In the process of "brainstorming" the team should install these root causes. An example of such a diagram while looking for reasons for which consumers receive a damaged product, is shown in Figure 4.

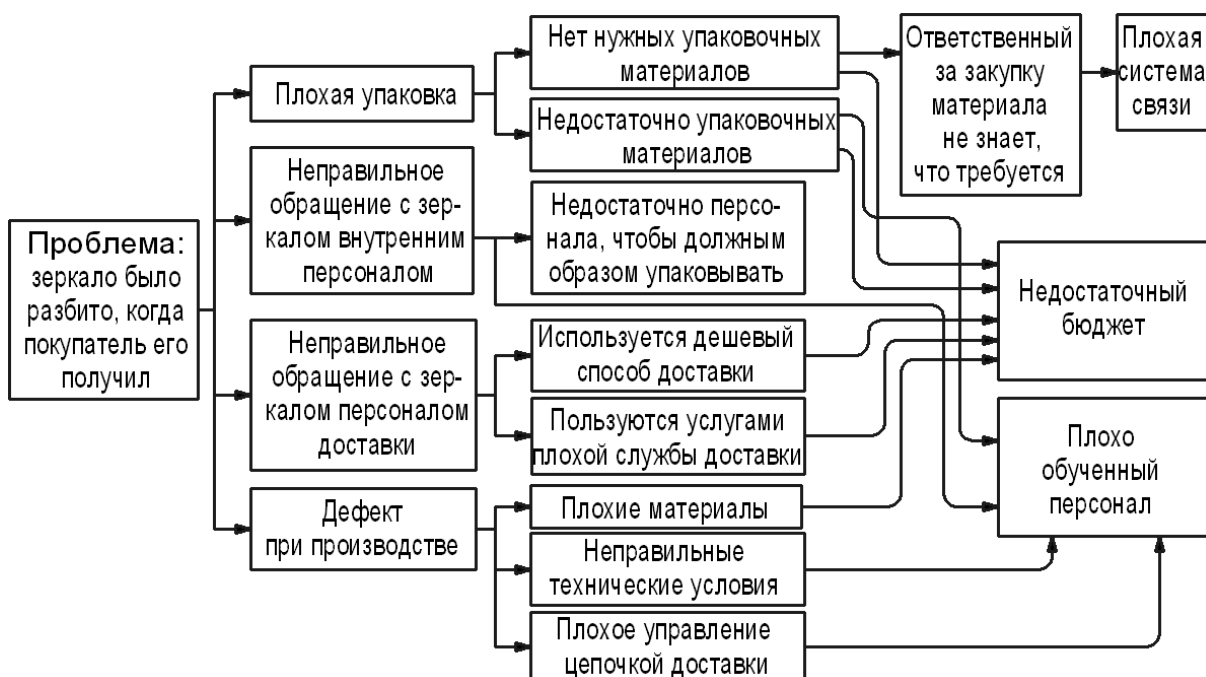


Fig. 4 – Tree diagram in searching of the main causes of the problem

Using the method of "why - why," members of the team found three root causes: poor communication system, low budget and poorly trained staff.

While searching for a means to ensure the quality characteristics of products, the consumer wishes to expand the tree diagram to allow characterization of the quality of the main components that can be implemented in practice.

Figure 5 presents tree diagram that converts unspecified consumer wishes to a number of technical properties of the product, which can be provided by its design and manufacture.



Fig 5. TD consumer wishes «easy handling», refers to adjusting key

#### 4. Matrix diagram (MD)

The matrix diagram allows visualizing the relationship between various factors and the degree of tightness. It increases the efficiency of the various tasks that take into account such interactions. The factors were analyzed using matrix diagrams are: problems in the field of quality and their causes, problems and their solutions, consumer product properties and their engineering characteristics, the properties of the product and its components, the quality characteristics of the process and its elements, the performance characteristics of the organization and the elements of the quality management system, etc. Figure 6 presents matrix diagram for factors components A и B.

A	B					
	$b_1$	$b_2$	$b_3$	$b_4$	$b_5$	$b_6$
$a_1$		△				
$a_2$						⊙
$a_3$			⊙			
$a_4$						○
$a_5$		○				
$a_6$						

⊙ - сильная связь  
 ○ - средняя связь  
 △ - слабая связь

Fig. 6 – matrix relations:  $a_1, a_2 \dots a_i$  и  $b_1, b_2 \dots b_i$  – components of the researched objects A и B, characterized by different tough relations

Figure 6 presents the most common matrix diagram. It is called the L-shape and is the relationship between the two groups of factors, is widely used in structuring the quality function and so has the quality of a table name. Information about the degree of closeness of the relationship between various factors represented by special characters that can more accurately perform simulations of these interactions and more effectively manage the different factors and processes. If it is necessary to analyze the relationship between the three factors, you should use T-shaped figure. To analyze the relationship between the four groups of factors is X-shaped diagram.

## 2. The order of the work

1. Do one of these teacher's tasks
2. Answer control questions.

### **Task 1**

Create affinity diagram for the factors that improve the properties of a given consumer product.

### **Задание 2**

Create a relationship diagram to identify the most significant (throttling) factors influencing the occurrence of defects in a given product.

### **Задание 3**

The resulting array of factors (reference 1) in the form a three-level tree diagram. At the third level, specify metrics for each factor.

### **Задание 4**

Develop the necessary measures to improve the performance factors specified items and display the relationship between them in the form of an L-shaped matrix diagram. Enter the weight of factors and determine the highest priority event