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FEATURES OF DETERMINING LABOR INTENSITY OF THE DESIGN AND TECHNOLOGICAL CUTTING TOOLS PRODUCTION PREPARATION

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Three levels of cutting tools indicators are considered; coefficients of acceptability, durability, accuracy and cost cutting tools are proposed, and desirability of coefficients set, which makes it possible to evaluate the effectiveness of cutting tools use at the design and technological production preparation stage.

Specific features of determining the production preparation labor intensity. In modern conditions of frequent production diversification the approach to determining the manufacturability coefficients should be refined for the design and technological production preparation. In particular, it is necessary to determine the frequency and duration of the use tools and equipment in the production process.

The details number and the frequency of structural elements meeting the same type in terms of their characteristic standard size, for example, the diameter of the hole in the parts, are determined in the product [1]. At the same time, in the process of design preparation for production, the structural elements sizes are estimated, which determine their production by cutting tools. Further, if necessary, in the process of technological production preparation, the duration of the use auxiliary tools and equipment, machines and devices is taken into account.

Statistical data analysis can be represented by histograms of the frequency and duration of the encounter and the use structural elements, cutting and measuring tools, etc.

Those constructive elements and, accordingly, tools that are rare, can be unified and replaced with frequently occurring ones.

The efficiency of using the cutting tool at the first level can be estimated by the coefficient of the conditional duration of use.

$$C_{Ui} = F_i \cdot D_i, \tag{1}$$

where Fi and Di - the frequency and duration of the detail element meeting and the use of the cutting tool, respectively.

Tools that are common and can be replaced by new, more effective ones should be evaluated by the second level indicators. This compares the indicators of the basic (previously used) and new instruments.

The criteria can be used:

tool life coefficient:

$$C_{TL} = F_N / D_B, \tag{2}$$

where T_N and T_B - the durability periods of the new and basic instruments, respectively;

detail material machinability coefficient:

$$C_M = V_N / V_B, \tag{3}$$

where V_N and V_B - cutting speeds with new and basic tools, respectively;

precision and quality coefficient:

$$C_{PQ} = (IT, Ra)_B / (IT, Ra)_N, \tag{4}$$

where $(IT, Ra)_B$ and $(IT, Ra)_N$ - the precision and roughness of the machined surface of detail structural element with the basic and new cutting tool, respectively.

Indicators or criteria of the third level characterize the cutting tool at the manufacturing stage. In particular, the cost coefficient of the cutting tool:

$$C_{COST} = C_B / C_N, \tag{5}$$

where C_B and C_N - the cost of the basic and new cutting tools, respectively;

payback coefficient of the cutting tool:

$$C_{PB} = COST_N / (C_B - C_N), \quad (6)$$

where $COST_N$ - costs for a new cutting tool.

The effectiveness of one or more candidate tools can be assessed at each of the given levels or in aggregate in points:

$$C_{EF} = C_U \cdot C_{TL} \cdot C_M \cdot C_{PQ} \cdot C_{COST} \cdot C_{PB}, \quad (7)$$

or by the generalized desirability function:

$$C_{DEF} = f(C_U, C_{TL}, C_M, C_{PQ}, C_{COST}, C_{PB}). \quad (8)$$

The cutting tool with the highest C_{EF} score is considered the most effective.

Desirability refers to one or another level of a parameter or criterion for assessing the effectiveness of the cutting tool use. On a special scale, the desirability value can vary from 0 to 1 (fig. 1).

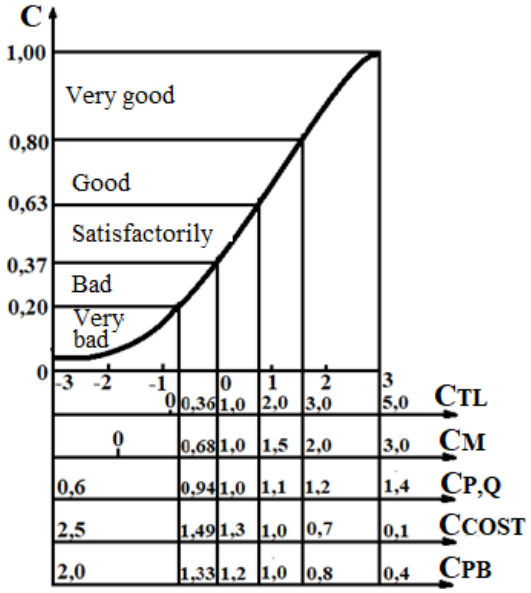

Fig.1. – Generalized desirability function of efficiency coefficient set of the tool use in production

The values of $C_{DEF} = 1$ correspond to the maximum possible criterion level, and $C_{DEF} = 0$ - the minimum.

The desirability function is described by the expression:

$$C_{DEF_i} = \exp(-\exp(C_i)), \quad (9)$$

where Ci - the dimensionless value of a parameter or criterion, given in accordance with the desirability scale. The generalized desirability function is formed as the geometric mean of the desirability parameters:

$$C_{DEF} = \sqrt[n]{C_{DEF_1} \cdot C_{DEF_2} \cdot \ldots \cdot C_{DEF_n}}. \quad (10)$$

Conclusion. As a result, to determine the effectiveness of the tool use an expert system has been proposed, which includes: a database on certain parameters of products, parts, cutting and measuring tools and other objects of the technological environment; analysis methods using mathematical statistics of the frequency and duration of the detail elements, tools and other objects meeting; procedures for assessing the condition of the instrument at the stages of its manufacture, operation and disposal.

REFERENCES

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