

# On structure of the system of the statistical analysis of its design parameter

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The design parameters of helicopters at a stage of conceptual projection are selected in view of a level, reached to the present time, of perfection, which is mirrored in values of statistical dates. Such dates can contain the items of information on own developments of the corporation, and also items of information obtained on the basis of handling of primary sources (the published descriptions or the specification of helicopters) and secondary information generators about developments (of the catalogues, reviews, analytical papers of periodic issuing). The results of a statistical analysis can be used by selection of design parameters. To them treat: the masses of the helicopter and his parts, aerodynamic coefficients, power parameters, and also specific parameters, criterion of efficiency etc. to the Designer are necessary the justified guidelines obtained on the basis of the analysis of available statistical dates from authoritative sources.

*Design parameter* - magnitude which is giving in to definition on a design stage, which quantitatively characterizes some property of the vehicle or condition of his operation. The system, considered in at present operation, of a statistical analysis guesses usage not of separate dates, and previously treated dates, introduced as, for example, statistical functional connections. It promotes forming of the guidelines, and in further acceptance of the rational solutions at projection. Statistically justified selection of design parameters of the helicopter, as against strong-willed (unfounded) selection, promotes lowering of a degree of hazard of a design error.

*A system of a statistical analysis of design parameters* - complete set(combination) of components as known, obtained by an experimental or calculated way of absolute and relative data values, which are organized in unified information base permitting by statistical methods to determine the tendencies of functional change (trends) of parameters to conduct the *comparative analysis* during projection. *The comparative analysis* - method of a design study of properties of plant with observance (holding) of rules of comparability by implementation of processes:

- matchings with analogs - at an estimation of properties of plant by comparison (statistical or analytical method) required parameters either criteria at equality or affinity of values other;
- matchings of versions - at definition of properties of plant on its structure, and also values of parameters of plant and its components. Is carried out with the help of graphic and calculated models for a series of versions of structure and parameters of plant (alternative calculations) with the purpose of preparation of the guidelines as dates for problem solving of synthesis.

In a fig. 1. the structure of a system of a statistical analysis of design parameters is reduced, where the contents of milestones of process of her operation is briefly indicated also.

Formalized, and the unformalized (semantic) information on helicopters is focused in an appropriate module of the database. Pursuant to a requirement specification on a query from the database the sampling of helicopters - analogs. Then the parameters of analogs are treated and the tendencies of functional change of design parameters in analytical and graphic form (trends) are determined. Thus it is possible to ensure split-hair accuracy only at «cut of redundant analogs» on the basis of the registration of specificity of constructions and level of their perfection. The treated thus dates are acceptable to forming the guidelines for the designer. There is *forming knowledge* - process of the analysis of dates and detection of latent regularities.

*Knowledge* - the authentic information, on the basis of which is possible to make the conclusions with the help of the inferences. The specially treated information is necessary for the designer which is convenient for usage. To focus such information it is expedient in a *knowledge base of the designer*.

*A knowledge base of the designer* - permanently updated, organized set of *knowledge*, which can immediately be applied at projection, and also is submitted in the shape, which admits automatic or automatized usage by the designer of this knowledge with the help of software. The knowledge base allows to accumulate, to save, and to transmit knowledge. The knowledge base as against the database contains not only particular items of information, as the reference material, but also exposition of common regularities and rules, that is more useful for the designer.

The statistical comparative analysis on the basis of known experience means on a final stage *interpretation* - process of definition of sense of obtained dates, which results should be matched and correct. The deriving of the structured results of the comparative analysis of design parameters of analogs, экстраполяционных of the tendencies of a probable development in the future allows to formulate the guidelines for the designer. The comprehension of the guidelines allows using to the designer obtained results for synthesis of versions and *support of acceptance of the design solution* - security of a face receiving the solution by the necessary information and the guidelines, ensuring facilitation of process of a justification of the design solution.

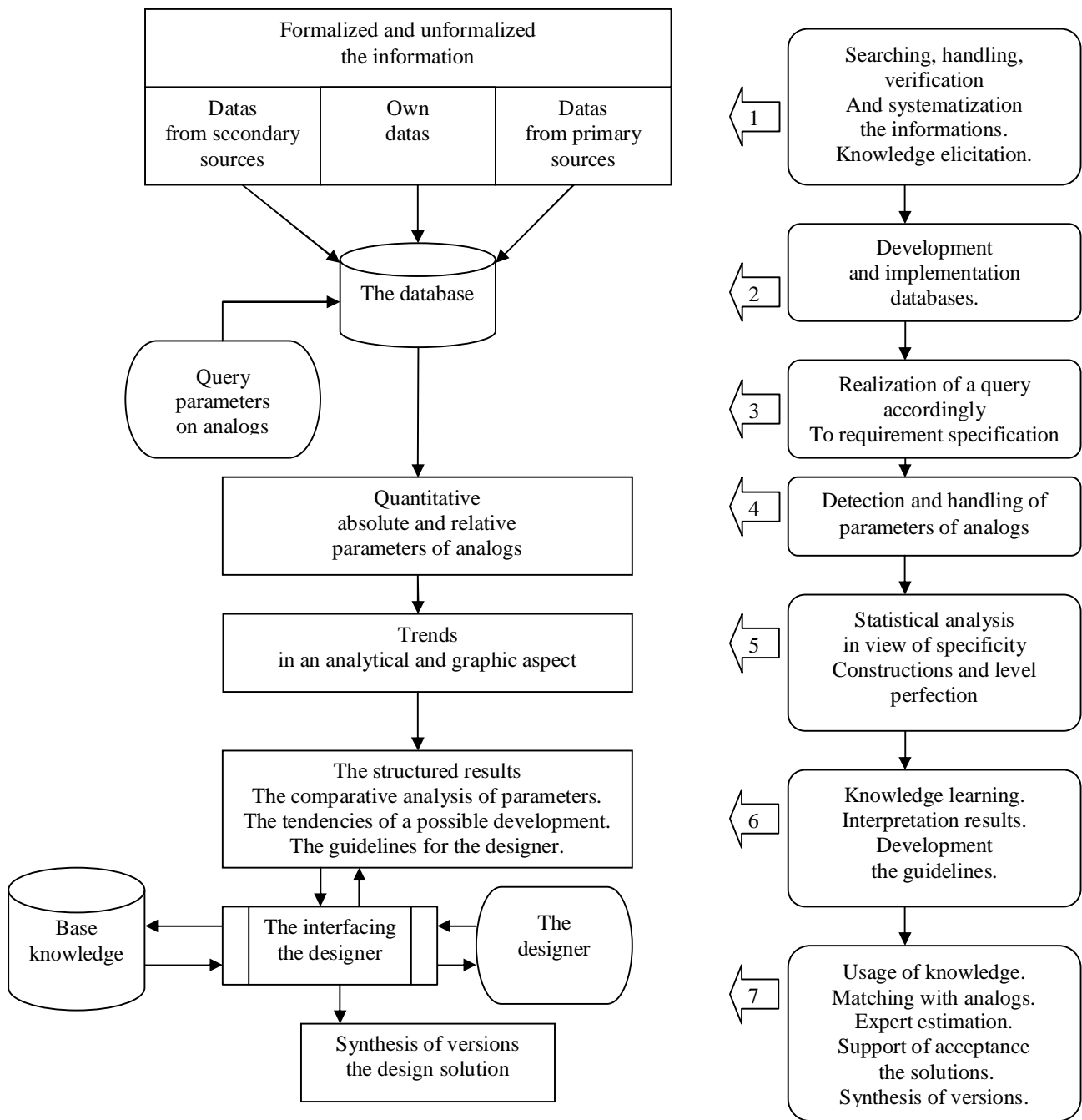


Fig. 1. Structure of a system of a statistical analysis of design parameters and contents of stages of process of it's her operation.

We shall consider some features, which are necessary for taking into account at the fifth stage of considered process. The known principles of construction statistically of justified relations (statistical formulas) will emanate from necessity of security of the greatest possible exactitude of prediction of magnitude of this or that parameter.

*1. Principles donating priority to this or that level complexities:*

*1.1. The amount of parameters of a multiple correlation at «global consideration» of type sizes of helicopters is criterion of justification of the formulas.*

Such formulas are difficult and are of interest not so much for deriving quantitative result, how many for reflecting common character of relation and development of influence of components. Besides complexity of similar generalized relations there is an estimation of reliability of approximating, and most important, such formulas try to describe constructions of helicopters of the different schemes, that contradict a principle of usage of analogs.

*1.2. The formulas of a pair correlation for one-type helicopters are simple and at the same time more precise.*

Such formulas (linear and degree) give more precise quantitative result. They are most acceptable to designer activity.

*2. Principles of calculation of masses distinguished pithily:*

*2.1. The exactitude of the forecast the above, than on the greater number of the *азрежамно*-isolated units is divided a construction of the helicopter.*

The principle differentiates units of one subsystem, in particular, of main rotor (main rotor hub, main rotor blade) and drive (engine, aggregates of a transmission), that superimposes additional limitations and creates conflicts.

*2.2. The breakdown on the functionally isolated parts, which correlation will derivate a flight vehicle as a system of an outline, allows to increase exactitude of the forecast of a mass of a flight vehicle.*

The principle is system, that is why more acceptable for construction of the weight formulas permitting to calculate a masses of new and modified vehicles.

Usage of the statistical formulas of a pair correlation allows (with reliability about 0,97) at stage of forming of a general view of the helicopter to use piecewise linearization of relations and ratio of modality by selection of alternatives (it is necessary, it is desirable, it is impossible, necessarily, it is undesirable, it is completely necessary etc.) at usage of a knowledge base.

For an example, it is possible to consider the formulas of a pair correlation obtained by the authors, for calculation of a mass of a fuselage of manned transport helicopters in range of maximum take-off masses - from 380кг (Mini 500) up to 56000кг (Ми - 26). On the database on 20 vehicles the performance of a mass of a fuselage in a function from a normal mass of the helicopter of a single-rotor configuration is described by an equation:

$$M_f = 0,1295 M_n$$

With reliability of approximating 0,98.

The mass of a fuselage in a function from a maximum take-off mass of the helicopter of a single-rotor configuration is described by an equation:

$$M_f = 0,1194 M_{t-o}$$

With reliability of approximating 0,98.

The mass of a fuselage in a function from a mass of the empty helicopter of a single-rotor configuration is described by an equation:

$$M_f = 0,211 M_e$$

With reliability of approximating 0,99.

The introduced equations of a pair correlation for the chosen class of single-rotor helicopters allow the designer, to plan measures on decreasing a variance between a preliminary calculated mass of a fuselage and obtained actually, to enter justified enough limit masses with an acceptable exactitude.

Usage of the statistical formulas of a pair correlation for the particular class of helicopters allows (with reliability about 0,97) at stage of forming of a general view to determine: a parasitic head resistance of a fuselage, mass and power design parameters of the vehicle to use piecewise linearization of relations and ratio of modality by selection by the designer of alternatives (type: it is necessary, it is desirable, it is impossible, necessarily, it is undesirable, it is completely necessary etc.).

Usage of a surveyed system descends *инновационный* hazard stipulated by acceptance of the unfounded solutions to speed up and to automatize process of projection, to increase efficiency and quality of developments.