Proactive Dictionary of Evaluation System as a Tool for S&T Indicator Development

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Introduction
The incompleteness of an indicators set for the First Russian Academic (FRA) Program has emerged as a result of an application of the Objectives-Resources-Results approach describing relationships between the program objectives, resources, and results (Zatsman & Kozhunova, 2009). In order to solve the problem and to develop new program-oriented indicators, we are designing the proactive dictionary as a tool for S&T indicator development. The design of the dictionary is based on two semiotic models:

- the model for a description of a frozen state of a process of S&T indicator development, named the frozen-state model,
- the model for a description of a dynamics of a process of S&T indicator development, named the time-dependent model (Zatsman, 2009).

Two Semiotic Models and Proactive Dictionary
These models are based on the Frege’s triangle, which consists of concept, name and denotatum vertices. In two models, each changeable indicator denotatum is a computer program of indicator computation together with corresponding source data, which are information resources of an evaluation system. The indicator names are given and changed by the experts, developing indicators.

According to the frozen-state model, the description of a state of a new developed indicator is made by experts as a descriptor of the proactive dictionary at a discrete point in time. In the model, three vertices of the triangle are encoded by the evaluation system into three following computer codes, recorded into the proactive dictionary at the discrete point in time: a semantic code for the indicator concept, an information code for the indicator name, and an object code for the indicator denotatum. The time-dependent model takes into account the variability of emerging indicator concepts, their names, and denotata. The model is based on the frozen-state model.

Each state of any developed indicator is described by experts as a descriptor of the proactive dictionary. Each descriptor contains a frozen-state indicator definition, its name, three computer codes and links to other descriptors, as well as references to source data, which are information resources of the evaluation system and computer programs, evaluating values of indicators.

The Experiment
We are performing an experiment on the development of a set of indicators of the authors’ age distribution of the articles of participants of the R&D thematic program of the FRA Program named “Basic research for medicine.” We proposed to develop a set of indicators to calculate the authors’ age distribution of the articles, dividing the participants into 14 age groups (20 – 24, 25 – 29 and up to 85 – 89 years).

For the experiment, we use data on a certain department of a scientific institute in Moscow. The department has 26 employees, but only 12 of them were authors of articles in scientific journals, issued in 2009. The total number of those articles is 69.

The results of calculation of two variants of a developed indicator are given in the form of graphs (see Fig. 1). Here we describe the first five stages of the experiment. Five experts take part in the indicator development: A, B, C, D and E.

First stage. Expert A creates first variant of the indicator having the following characteristics:
- if an article has been written by co-authors, corresponding age groups receive 1 point for each author;
- the normalization procedure using the size of age groups is not applied.

At the same time (at the first stage) experts B and C create together a second variant of the indicator with same first and the third characteristics, but the second one has a different value: corresponding age groups receive 1/N point for an article having N co-authors.

Second stage. Now the expert C changes his/her mind and agrees with the expert A. In other words, the expert C refuses to coordinate the second variant of the indicator, thinking it is right to add just 1 point to each of co-authors, thus coordinating the first variant of the indicator.

Third stage. Experts A, B and C decide to take into account, when calculating values of their indicators, the number of people in each age group—the normalization is used in the calculations.
Fourth stage. Experts A, B and C decide to take into account only articles printed in the journals from the rating list of the Russian Certification Commission.

Fifth stage. Now the experts remain unchanged states of their variants of developed indicators. Yet the points of view of some of them change. The expert C refuses the variant of the expert A. Two other experts, D and E, join to the second variant of the indicator.

Figure 1. Results of calculation of two variants of the developed indicator.

Conclusion
The proactive dictionary shows new possibilities for developing S&T indicators for evaluating R&D thematic programs of the FRA Program, specifying states of developed indicators as descriptors. The dictionary is a tool for coordinating the work of the experts responsible for the development of indicators. In addition, the dictionary contains information on all stages of development of each indicator. This allows experts to use, if necessary, previous versions of indicators in the process of development. Descriptors of the proactive dictionary set a one-to-one correspondence between the program, calculating values of the indicator, and its name. Each descriptor fixes a rule of selecting source data which are used in calculating values of the indicator. That is why the process of confirmation of any new indicator is a simultaneous approval of the following entities: its name, its definition, the computer program of calculating its values, and the rule of selecting source data used in calculating its values.

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References