Experts and expertise at competitive selection of scientific projects

Vladimir Arlazarov [1],*, Valery Krivtsov [2], Vera Farsobina [1] and Igor Janiszewski [1]

[1] *Research Center "Informatics and Management" of the RAS, 119333, Russian Federation, Moscow, Vavilova str., 44/2;*
E-Mail: vera@cs.isa.ru (F.L.); igor_y@cs.isa.ru ;

[2] *Moscow Institute of Physics and Technology (State University), 141700, Russian Federation, Moscow Region,*
Dolgoprudny, Institutskiy per., 9; E-Mails: krivtsov@phystech.edu
*   correspondence email: arl@isa.ru ;

Abstract
The task of the organization of expertise of scientific projects is being understood in this work. Topical issues of quality of expert work are discussed. In a basis, consideration of problems of selection of experts and definition of criteria based on which the expert decision is developed is necessary. Model examples of economy of examination and calculation of number of experts at a choice of the best project are given.

Keywords: experts; competence; complexity of expertise; economic model; probability of error

1. Introduction

The present article is devoted to a question of the organization of expertise of the scientific projects offered to financing within scientific funds, the academic and departmental programs, etc. Before passing to substantial consideration of the problems arising on this way, it would be desirable to make two essential preliminary remarks.

This work does not set at all as the purpose to make exhaustive recommendations about each case in point. The task was set a little different: to show the arising problems in their interrelations and basic ways of their decision. Therefore, in particular, all used models are very simple and illustrative. Applicability of the general theory and methods of decision-making is only designated by places.

The second remark concerns questions of reduction of influence of biased experts. We recognize that the persons establishing rules and making the decision are deprived of any personal interest in a final choice. Otherwise, there is absolutely other perspective, and ways of its decision are far from ones considered in this work.

2. Results and Discussion

2.1. Competence of the expert and complexity of expertise

The problem of selection of experts and criteria of an assessment for determination of value of the works offered by scientists is among the major since the issue of assignment for researches in various competitions, which are carried out by funds, departments, corporations, etc. exactly here is in most cases resolved. The idea of independence of the involved experts is beautiful, but is practically not well founded since assumes their weak competence. Rather competent, working in the field people are always biased, at least because belong to one of several, as a rule, competing, the directions. Certainly, it by no means always assumes an involvement; often these people are subjectively certainly honest.

Nevertheless, anyway, it is not necessary to speak about full objectivity of the most competent people.

The most natural approach to the solution of this problem: "let all flowers blossom" - is not always applicable because of limitation of resources and technical difficulties. Ideally, its preview has to precede appointment of experts to each work. It is possible only in unique cases (for example, competition on receiving a government award), but not in mass competitions.

Other vital issue of expertise – care and a specification of the estimates given by experts. From the point of view of the persons making the decision, it is desirable to have the detailed questionnaire reflecting various aspects of the considered work: relevance, prospects, the available reserve on a problem, reputation of the organization and/or group of performers, etc. Such questionnaires are developed and widely used. On each question, the scale on 2-5 answers is offered. The task of the expert is to choose the answer and to put "tick".

Further, the mechanism on decision-making at many criteria and many experts turns on. Such mechanisms are based on the existing theories [[1]-[8], [13]]. It is possible to think up the new. The integrated assessment by which projects will be ranged is usually a result of operation of such mechanism (system). It is also possible to create a system into which will be loaded with all the experts completed the questionnaire. With this system, it will be possible to perform ranking projects analyzing the array of available questionnaires in general.

Fundamental difference of systems of the last type [[14]] is that the weight of criteria are not defined initially, and can change depending on dispersion of the estimates, which are really acquired by this criterion.

Even at the most carefully worked questionnaire the scale with 2-5 answers bears not enough information. Moreover, in some important cases it is almost impossible to give an "objective" assessment in general. If on a question: whether "is the project manager a scientist with a world name?" - at the expert from the competing school still it is possible to get the highest point, on a question: "is the offered method the new word in science?" it is simply improbable.

For this reason and because experts did not "earn some money", additional measures of check of coherence of answers are often taken. For example, apart private questions, ask to count up and fill an integrated assessment. Also, every expert has to choose one of the proposed alternatives and then explain his decision. All this gives the chance in disputable cases to receive additional information.

2.2. Elementary economic model of expertise

However, it is necessary to consider important circumstance – fee of experts. Often experts work free as it is accepted, for example, in the majority of editorial offices of scientific magazines. Many scientists consider for themselves obligatory and even prestigious to perform expert work but only if loading is not great. If the expert for short term needs to review 15-20 competitive documents, then this work is paid. Now we will carry out model calculation. Let

V - reading speed at the expert (pg./min.)

M - average of pages in the demand

N - number of columns of the questionnaire

t - time for filling of one column (min.)

W_e - payment of the demand

W_m - average monthly earnings of the expert

$C \approx 8*25 = 200$ - number of "working" hours in a month

Then time for reviewing of one demand equally

$$\left(\frac{M}{V} + N*t \right)$$

Conditional earnings of the expert when reviewing

$$P_e = \frac{W_e * 60}{\left(\frac{M}{V} + N*t \right)}$$

the average cost of hour of work of the expert

$$P_{avr} = \frac{W_m}{200}$$

It is clear, that in order that work on expertise was "self-sustaining" it is necessary that the inequality be carried out.

$$P_e \geq P_{avr}$$

Or

$$\frac{W_e * 60}{\left(\frac{M}{V} + N*t \right)} \geq \frac{W_m}{200}$$

Where

$$\frac{W_e}{W_m} * 12000 \geq \frac{M}{V} + N*t$$

For example, when

$V = 0,25;\ M = 20;\ W_e = 1000;\ W_m = 120000$

we have

$N*t \leq 20$

The given model is very rough. It is risky to estimate reading time on number of pages for the scientific text; counts in questionnaires significantly differ on difficulties, time "on thought" is not provided, etc. However, even this simple model shows that excessive specification of the questionnaire and the requirement of detailed justification of each answer not only irritate the expert, forcing it to replace intuitive feelings with accurate formulations (that enters a task of originators), but also can make work of the expert

"unprofitable" that isn't always acceptable. Even if expertise is paid, the expert tries to minimize part of work, unproductive from his point of view, and its sharp increase can lead to the conflict. Especially it concerns to the experts who are working free.

2.3. Integrity of experts and publicity

Much attention is paid to fight against bias of experts recently. Can be even bigger, than it deserves that. Nevertheless, there are grounds for it. It should be noted that in many cases the work of experts is not "transparent". In contrast, for example, from the fact of the publication of a "weak" article, which negatively affects the reputation of the scientist.

Certainly, the first weapon against bias is publicity. Many organizations holding competitions publish texts of offers and, usually after carrying out expertise, names of the supported winners of experts. Texts of not supported offers and names of the experts who gave them estimates practically are never disclosed.

In the scientific world publicity is the important means of support of reputation. It is important still that at the end of research its results were published on the Internet. They cannot be replaced with publications in scientific magazines, especially, of the prestigious. There are several reasons for that.

First, publications are not always easily available and if the expert wants to take an interest in results of particular work for which money was allocated, hardly he is going to compile these publications.

Second, according to publications it is difficult to present an overall picture of the performed work whereas the report has to show this picture.

Third, if work is performed for public (especially, state) the account, society has the right to see on what money were spent on.

The idea that reports are usually overflowed with the general words, unnecessary details and other "trash" is, of course, true, but changes nothing.

Besides, the expertise of reports, which has no competitive character any more, is simply obliged to be open.

Good example of influence of publicity is the publication of all theses in open Internet access, together with responses of opponents and the leading organization.

2.4. Random choice in fight against bias

Still we leaned on the fact that scientists, as a rule, seek to protect the reputation. Also direct methods of reduction of influence of the "interested" experts can be applied. The most effective of them is a casual choice of experts or expertise.

In this case, the bigger number of experts is involved in expertise, than it is necessary, and the choice of the necessary number of experts is made automatically in a random way just before or after carrying out expertise. The casual choice of experts from rather big list of experts in area, which possesses the project, sharply complicates opportunities to agree with experts and in general objectify a situation a little. Some payment for increase of objectivity is inevitable decrease of the average level of expertise. On the other hand, if interests of one of the persons participating in the organization of expertise are infringed, in general a little that changes a

preliminary choice of experts.

The choice from already carried out expertizes is even more effective. However, the latter demands essential increase in expenses.

Various schemes of use of a large number of experts are possible. In refereeing of sports, competitions often applied scheme of rejection of several extreme estimates and averaging of the others. Another method is to choose expertise in a random way.

Again, we will construct unpretentious model.

We will consider that costs of expertise are proportional to number of experts. Let there is a function giving probability of the wrong decision at the set number of experts. At last, we will put that we are ready to pay some sum for reduction of probability of a mistake.

So, let

n - number of experts,

$p(n)$ - probability of a mistake at n experts,

$f(p)$ - acceptable expertise cost at probability p ,

W_e - cost of one expertise.

Then obviously, the acceptability of attraction of n experts is defined by an inequality

$$W_e * n < f(p(n))$$

For example, if $f(p) = \dfrac{a * \varepsilon}{p + \varepsilon}$, where a - the most admissible cost of expertise, inequality takes a form

$$W_e * n < \frac{a * \varepsilon}{p(n) + \varepsilon}$$

Or

$$p(n) < \frac{a * \varepsilon}{W_e * n} - \varepsilon = \varepsilon * \left(\frac{a}{W_e * n} - 1 \right)$$

Believing $a = W_e * n_{max}$ we will receive

$$p(n) < \varepsilon * \left(\frac{n_{max}}{n} - 1 \right)$$

so it is possible, to estimate at what n it is an inequality it is carried out, and to choose the corresponding n (instinctively or having set and having solved the optimizing task).

The assumption that the cost of one expertise is constant, it is possible to try to cancel. It is quite probable that in the presence of a large number of experts it is possible to simplify the questionnaire and to reduce the price of expertise, practically without reducing the general probability of the objective answer.

The formula (1) thus does not change, only a cost of expertise W_e becomes function from n .

2.5. How many experts are needed?

Key problem of this model is the method of calculation of probability $p(n)$, the represented quite abstract value. However, if some of the considerations determine certain parameters, it is possible to construct this function and to calculate its value.

Let each conscientious expert give the mark which is a random variable with average value of M where M is the correct (in some sense) assessment. It is possible to be set by the law of a deviation of an assessment from M in some scale containing d of values. Then it is possible to use standard statistical tools and to count, at what number of experts the deviation of average value from M won't exceed the set number ΔM with probability not smaller some γ

$$p \left\{ M - \Delta M < q_{cp} < M + \Delta M \right\} \gamma$$

Thereby it is possible to calculate probability of a mistake at a choice of the best project at true values of estimates M_1 and M_2 .

Under some conditions the necessary number of experts of N can be set by a formula

$$N = \frac{0{,}04 d^2}{\Delta M^2 (1 - \gamma)}$$

Having accepted value $\gamma = 0{,}9$, usual for such cases, we will receive

$$N = 0{,}4 * \left(\frac{d}{\Delta M} \right)^2$$

where d - the total of divisions of a rating scale, and ΔM the tolerance

Once again, we will emphasize model character of our formulas. In work there are 21 similar formulas, at various assumptions, (including the one brought by us), and the author refers to article [[10]] where 98 options corresponding to different combinations of aprioristic information are given.

Now we will assume that there are interested experts among the others which bring a systematic mistake, thus shifting an average in a certain party at a size R . Then it is possible to calculate change of average value and probability of a mistake depending on values M , R , ΔM , number of unfair experts and algorithm of work with expertise.

We will notice that the theory of decision-making offers a number of methods of work with the estimates acquired from many experts. Among them, there are also methods of definition of experts with sharply deviating average estimates, rejection of these estimates and ranging of experts in competence [[11], [12], [14]]. Therefore, there are plenty for the leader to choose from. It is important to correlate the arising additional expenses to the value of the result.

3. Conclusions

In this work, we tried to raise some questions the connecting competences of experts, their integrity and interest with desires and opportunities of organizers of expertise, such as increase in number of experts, publicity of results or complication of structure of expert opinions.

Models of these interrelations are studied so far very poorly whereas single questions of decision-making at expertise are worked very deeply.

Creation of such models relying on traditions of scientific

community has to give base for development of the acceptable schemes of the organization of expert work to the people responsible for a choice of the most significant projects.

Conflicts of Interest
The authors declare no conflict of interest.

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