Research of the Agree of Experts' Evaluations in the Estimation of Software Systems

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Abstract: **The article deals the task of comparing of agree of the results of expert evaluation conducted by several independent groups of experts of the software of teacher' rating of higher educational institutions. The resulting evaluation of the expert group calculated by the modified method of expert evaluation of software systems based on interval data analysis. The resulting evaluation of expert groups will can improve the "weak" aspects of the software system and can help conduct analyze the expert assessments too.**

Keywords: **expert evaluation, methods of interval data analysis, software system, teacher rating system.**

I. Introduction

One of the important tasks of the present is the research of one of the most important characteristics of software systems - quality. Under the quality of the software system, we understand the set of the software product properties, which characterizes its ability to meet the established or predicted needs of the customer, which he expressed in the form of user requirements for software in the early stages of its development [1]. One of the most important attributes of a software system's quality is the functional capability, that is, the ability of the system to perform its functions over a certain period of operation within predetermined limits and under certain operating conditions [2, 3]. Nowadays, a large number of leading scientists of Ukraine and the world is involved in the study of these issues and expert evaluation is a common method for estimating the quality of the software system. Expert (lat. Expertus - experienced) evaluation (expertise) - a method of obtaining summary information by the way of estimation a situation, event or phenomenon by a group of independent experts [4]. Such generalized information is obtaine through an expert survey, which involves specialists in the area that interests the researcher. The task of an expert is to formulate his own opinion about the object under research or the phenomenon on a certain scale in accordance with the prescribed rules. The main problem of expert evaluation is the choice of competent in the study area experts, which have an unbiased attitude to the object of research and had a critical attitude towards all that evaluates, especially if it is a study of software systems whose lowly quality and may endanger the life of a person or of humanity [4].

In view of the above, the task of studying agree of expert' evaluations of different groups in estimating software systems of any practical or theoretical direction is actuality.

II. Statement of the Task

The evaluation of the software system quality begins from the early stages of development, including the definition of the specification requirements for the software system, analysis, design, etc. The quality estimation process at these stages usually involves design engineers who themselves evaluate some part of the system they are developing. After that, the results of their estimations are integrating and averaging. Of course, the resulting evaluation in this case will be overestimated [5].

Approaches and recommendations for the process of expert evaluation of the software systems quality in various scientific schools, studies by individual scientist cover various aspects of this issue. Some works try to formulate recommendations for the evaluation process. In the work [6] a critical analysis was made to cover all the attributes of the software systems quality that need to be accounting in the expert evaluation of systems. In particular, in the paper [7] we consider the methodology for evaluating the quality of web-projects. The authors proposed to evaluate quality not by formal numerical measurements, but in the form of relations and preferences with the application of the logic of antonyms [8]. The drawback of this method, in our opinion, is the using limit. It only can be use to obtain an end-user evaluation. In the works [9-11] a method of calculating the quality evaluation of software systems by a set of criteria from different groups of participants in the development process is proposed. The results of the expert evaluation of software systems quality according to various criteria by this method also allowed to developing a method of visualization of the information on the estimates using polar diagrams. However, this method has a number of remarks that discussed in the work [12].

One of the important drawbacks of the method is the exact formalization of the expert's opinion when evaluating a particular criterion [12]. The paper [6] provides information on the real economic and environmental impacts that may occur not only in the life of some company but also ordinary people, with insufficient evaluation of a particular project at various stages of its development. Therefore, the choice of experts and giving him the rights for objectively evaluate the proposed software systems is extremely actuality.

To take into account the possible questionable expert evaluations according to certain criteria, the method of expert evaluation of the software systems quality to be realization using the methods of interval data analysis are proposed [3,12-14].

Interval evaluation of the software system based on the set up of the upper and lower limits [14] of the permissible expert estimation according to a certain criterion:

$$x_{m,k} \in [x_{\min}; x_{\max}], \quad (1)$$

where $x_{m,k} \in [1..10]$ - the evaluation is set by the expert on a certain criterion; m - the number of criteria for evaluation; k - the expert; $x_{\min} = x_{m,k} - \delta \cdot x_{m,k}; x_{\max} = x_{m,k}$; δ - the percentage of deviation from evaluation the set by the expert, which can be determined for each project or expert, depending on the "degree of trust" to the expert.

The resulting expert evaluation has the form:

$$[X_k] = \sum_m [x_{\min}; x_{\max}] \cdot c_m, \quad (2)$$

where $[X_k] = [X_k^-; X_k^+]$ - interval evaluation of the expert of the area, which takes into account the percentage of the expert's rating deviation from the nominal value; c_m - percentage indicator of importance of the criterion of software evaluation, $\sum_m c_m = 1$.

The resulting evaluation of the software system quality in this case will take the form:

$$[X] = \frac{\sum_k [X_k] \cdot q_k}{\sum_k q_k}, \quad (3)$$

where q_k - the weight indicator of the individual group; $[X] = [X_{ex}^-; X_{ex}^+]$ - the resulting evaluation of all groups of experts, which is the interval of confidence to the software developing.

The condition of the agree of the obtained interval estimation of the software system quality to the admissible is [3,6]:

$$[X_{ex}^-; X_{ex}^+] \subset [X_{\min}; X_{\max}], \quad (4)$$

where $[X_{\min}; X_{\max}]$ - the established interval of software evaluation, which is guaranteed to satisfy software developers.

III. Example of the Expert Evaluation of the Software of Teacher's Rating of Higher Educational Institutions

In Fig. 1 schematically illustrated the process of expert evaluation the quality of the software system.

As we can see from the figure, the resulting evaluation of the software system quality depends on the estimates made by experts at the initial stage.

We will conduct a comparative analysis of evaluations put forward by different groups of experts on the example of the software of teacher' rating of higher educational institute. Shortly about the rating system of teachers. The first version of this system developed by the Master of the Department of Computer Science in 2017. In Fig. 2 shows the main window of the system.

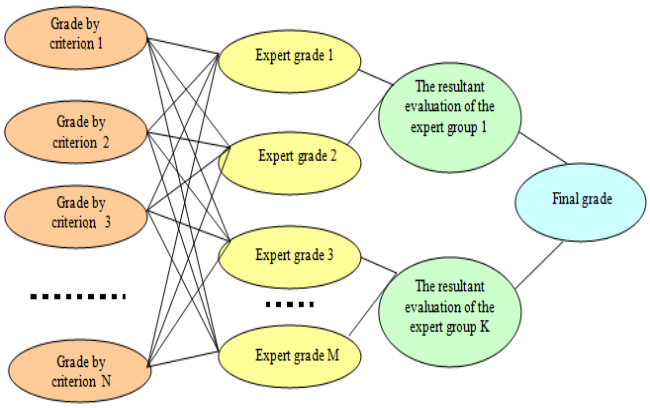

Fig. 1. The process of expert evaluation

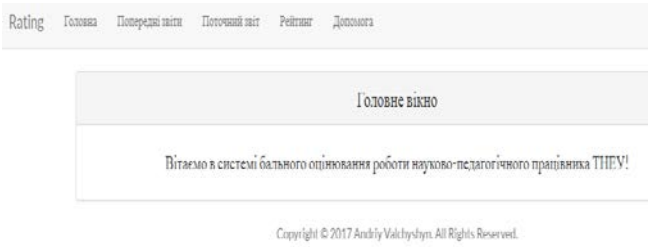

Fig. 2. The main window of the system of teacher' rating

On Fig. 3 is provide the general rating of university teachers.

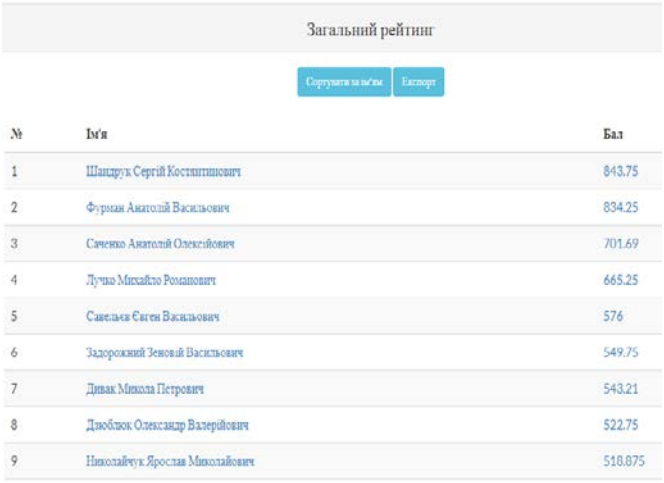

Fig. 3. The general rating of university teachers

Evaluation of the work of the scientific and pedagogical workers of the university has a cumulative character, takes into account data for 5 years and it calculated by the following formula:

$$I = P + \sum_{i=1}^{4} 2^{-i} P_i, \quad (5)$$

where I - the evaluation of the work of the scientific and pedagogical workers for the last 5 years; P - the evaluation of the work of the employee for the reporting year; P_i - the evaluation of the work for the previous 4 years.

The work of the teacher evaluated in the context of such activities as research work, educational work, methodical work, organizational work, qualifications and additional criteria. On fig. 4 showed one of the windows for capability reporting.

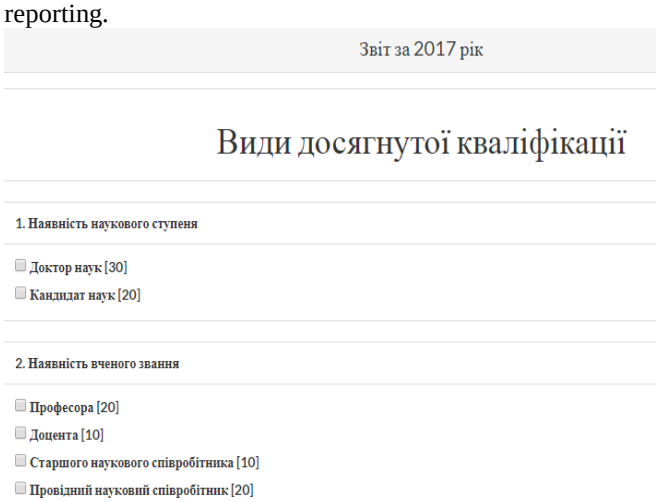

Fig. 4. Form to fill out the report by the teacher

To evaluate the quality of this software system in an objective way and the possibilities for its further perfection and improvement, it decided to conduct its evaluation. Leading departments of the Faculty of Computer Information Technologies were in the role of expert groups.

The software system evaluated according to the following criteria [12]:

1. The correctness of the work (the system must be isolated from external influences and the result of performing the functions should be correct in all conditions).
2. Protection from unauthorized access
3. Program reliability (the system must be resistant to various user-side influences)
4. Comfortable graphical user interface
5. Low cost of hardware resources (the system should not require high hardware costs of the computer)
6. Mobility (the system should have a small amount of memory, a small amount of processor time, etc., so that it can be used on any PC)
7. Scalability (improving the capabilities of the system by introducing a new functional)
8. Convenience of use
9. Speed
10. Completeness of functional requirements (the system must meet all of its functional requirements from the side of the subject area).

The software system was evaluated by the experts of the following categories: expert in the area (in the table - EA), business analyst (BA), software architect (SA) and expert of user interface (EI). Percentage coefficient importance of the criterion c_m for each of the criteria listed above, accordingly 0,05; 0,05; 0,05; 0,1; 0,05; 0,05; 0,05; 0,1; 0,1; 0,4. System developers want to achieve system quality with a minimum threshold of 80%. Below in the tables 1-3 shows the upper limit for the expert's estimate. The lower limit of the evaluation will formed with a deviation 5% from the upper one in order to take into account the "doubts" of experts of the setting score.

TABLE 1. EVALUATION OF THE SOFTWARE SYSTEM BY EXPERTS FROM THE DEPARTMENT 1

№	EA	BA	SA	SA	EI	EI
1	9	9	8	9	8	8
2	9	9	8	7	8	7
3	9	8	9	9	9	8
4	8	8	9	9	7	9
5	9	9	8	9	8	8
6	8	7	9	9	9	8
7	8	8	8	8	8	8
8	9	9	9	9	8	9
9	9	8	9	7	9	9
10	9	8	8	8	8	9
Weight indicator of each expert	**7**	**8**	**9**	**9**	**9**	**9**
The resulting evaluation of a group of experts	[8,35;8,8]	[7,79;8,2]	[7,91;8,33]		[7,96;8,38]	
The resulting evaluation of the project					**[7,97;8,39]**	

TABLE 2. EVALUATION OF THE SOFTWARE SYSTEM BY EXPERTS FROM THE DEPARTMENT 2

№	EA	BA	SA	EI
1	7	8	8	7
2	8	9	7	8
3	8	8	7	8
4	7	8	8	7
5	7	9	7	7
6	7	9	7	7
7	7	9	8	7
8	7	7	7	8
9	8	8	7	7
10	7	8	7	7
Weight indicator of each expert	**7**	**8**	**9**	**9**
The resulting evaluation of a group of experts	**[6,84;7,2]**	**[7,7;8,1]**	**[6,8;7,2]**	**[6,8;7,2]**
The resulting evaluation of the project			**[7,1;7,4]**	

TABLE 3. EVALUATION OF THE SOFTWARE SYSTEM BY EXPERTS FROM THE DEPARTMENT 3

№	BA	EA	EA	EA	SA	SA	SA	EI	EI	EI
1	9	10	8	8	9	9	8	7	9	9
2	8	9	7	4	8	3	7	9	7	8
3	8	9	5	4	8	5	8	7	7	8
4	8	7	7	4	9	8	6	7	9	8
5	9	10	10	8	9	8	8	8	9	9
6	7	10	8	4	7	8	6	4	6	7
7	8	10	10	7	8	9	7	5	8	8

8	8	9	8	7	9	8	7	6	7	8
9	8	10	10	8	8	7	8	8	6	7
10	8	10	7	7	7	9	8	7	6	7
The resulting evaluation of a group of experts	**[7,6;8,1]**	**[7,5;7,9]**			**[7,4;7,8]**			**[6,8;7,1]**		
The resulting evaluation of the project								**[7,2;7,6]**		

Consequently, from the expert evaluation of the rating system of the university teachers, the main quantitative estimates of which given in the tables, we can conclude that in fact the results of the evaluation of only one of the three expert groups are consistent with the initially established interval of evaluation of the software system, which satisfies the developers.

IV. Conclusion

The paper is devoted to the problem of studying and evaluating the quality of software systems. The methods of expert evaluation are considered. It indicated that most of them carry only theoretical recommendations for improving the evaluation process. Some methods aimed at improving the visual presentation of the evaluation results. The results of the analysis showed the actuality and importance of paying special attention to the selection of experts who would evaluate software systems so that their opinion was objective and unbiased. It proved that, in order to avoid "doubts" regarding the evaluation of a particular criterion, use the methods of interval data analysis. The method of expert evaluation of software systems based on the analysis of interval data is developed, the result of which is to check the agree of the resulting interval estimation according to the project proposed by an independent group of experts and the set the interval of evaluation of the software system that satisfies the developers. On the example of the expert evaluation of the rating system of the university teachers, the diversity of opinions of different groups of experts shown.

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