Calculation of the integral quality index of a scientific event in the context of the interests of a scientific institution

Hryhorii Hnatiienko [1], Vitaliy Snytyuk [1] and Nataliia Tmienova [1]

[1] *Taras Shevchenko National University of Kyiv, Volodymyrs'ka str., 64/13, Kyiv, 01601, Ukraine*

Abstract

The concept of scientific action is introduced and the concept of a scientific event is proposed. New approaches to assessing the excellence of training and the quality of the scientific event are considered. A mathematical model for quantifying the performance index of a scientific event in the context of the interests of the organization is proposed. Approaches to aggregation of attributes of scientific actions are investigated and types of convolutions of partial criteria are given. Heuristics to define the mathematical model with information that is missing when filling the database of scientific actions are introduced. It is proposed to divide the problem of determining the effectiveness of a scientific event into three stages. The attributes of each of the three stages of conducting and evaluating the effectiveness of the scientific event are considered. Prospects for further research on the problem of evaluating the effectiveness of scientific actions carried out by a particular organization are presented.

Keywords

formalization, scientific action, scientific event, aggregation, integral quality of the event, expert evaluation, decision making, interests of the organization

1. Introduction

Our time is characterized by a wide variety of manifestations of human activity in various fields and at the same time the desire of different institutions to unify this diversity in order to restore order and ensure coherence and interaction between different institutions. In particular, to solve the problem of commensuration, state regulators and international institutions create regulations and formalize the interaction between teams of people from different fields. The scientific space is also characterized by the difficulty of measuring results, a wide range of approaches to comparing the activities of scientists and research teams. In this regard, there are generally accepted agreements on scientometric databases, metrics of scientific action, criteria of publication activity, citations, impact indices, quantitative indicators of productivity, impact factors, etc.

Determining the intellectual and scientific level of any scientific event in modern large-scale information flows is an important scientific problem. The main factor in the scientometric approach to calculating the level of a scientific event should be its efficiency and effectiveness. The problem of determining the quality and effectiveness of scientific research is poorly structured, therefore it is necessary to take into account subjective factors at all stages at its solution. In this case, to adequately solve this problem, we should choose criteria that reflect the purpose and comprehensively characterize the quality of the scientific event.

High quality of scientific actions (SA), which ensure a high level of reliability of scientific information, is a necessary condition for sustainable development of science and technology because science is based on the principles of presumption of proof [1]. Therefore, adequate evaluation and even better quantitative evaluation of any scientific event (SE) are especially important and

XXI International Scientific and Practical Conference "Information Technologies and Security" (ITS-2021), December 9, 2021, Kyiv, Ukraine
EMAIL: : g.gna5@ukr.net (H. Hnatiienko); snytyuk@gmail.com (V. Snytyuk); tmyenovox@gmail.com (N. Tmienova);
ORCID: 0000-0002-0465-5018 (H. Hnatiienko); 0000-0002-9954-8767 (V. Snytyuk); 0000-0003-1088-9547 (N. Tmienova)

promising. This will facilitate the possibility of comparing scientific events with each other, comparing the level or significance of periodic events in different periods.

The growth of the total number of SA, the increase in the volume of articles submitted for review and presented at particular SA, the spread of scientific content of scientific events as a result of technology development, the evolution of universities and scientific research have increased the risk of dissemination of poor quality scientific information [2]. The presence of low-quality publications in proceedings of scientific events not only lowers the rating and threatens the reputation of individual authors, SA, publishers, any repository in which they are located, but also weakens the desire of all participants to ensure high-quality scientific events [2].

All this requires the introduction of a mathematical apparatus for adequate comparison of SE in the scientific space of Ukraine. This is due, in particular, to the fact that the current stage of human civilization development is defined as the transition to a society of knowledge and is characterized by qualitatively new requirements for the development of science. Moreover, the scientific space is a structural element of social space and can be considered as a complex poorly structured system.

2. Classification of scientific activities

Scientific space is a network of cognitive processes within which science operates [3]. The concept of scientific space outlines the complex configuration of not only the knowledge component of science but also the scientific infrastructure which includes scientific institutions, scientific communications, processes of scientists training for professional activities, etc. [4, 5]. SE is a component of the scientific space, which in turn is a complex poorly structured system, which should be studied by methods of decision theory. At the same time, the study of scientific space is a difficult formalized task. Therefore, its formalization can contribute to meaningful and sound decision-making in this subject area [6].

Note that formal procedures for determining the level of scientific publications are widely used by scientometric databases. But this is done in order to maintain the high quality of scientific publications at the world level. At the same time, such an approach may be considered necessary for further research. After ensuring the necessary conditions of scientific integrity and high quality of the SA, an additional study of the "sufficiency" of the SE in the context of the interests of the scientific institution may be conducted. Exactly like this perspective of research is relevant in today's competitive world, in particular, in the field of research and comprehensive rankings, which are widespread in the modern world.

Today there is a great variety of SA [7, 8]: congress, symposium, forum, conference, round table, school, seminar, exhibition, etc. [9, 10]. All these activities after their realization, i.e. their implementation and achievement of their goal, will be referred to as a scientific event. Depending on the scope, SE is accepted to differentiate between scientific and theoretical, scientific and technical, scientific and practical. In addition, depending on the area covered, SE can be international, national, interregional, regional, etc. But such a classification is too superficial and can not serve a quantitative study of the importance of SE. Gradation of SE should be more reasonable, detailed, and formalized [11, 12].

The given list of SE is not exhaustive. In particular, taking into account the scope of this article, SE can also be considered as a publication of a scientific monograph, the publication of the next issue of the periodical edition, its indexation in scientometric databases, and more.

SE is a form of organization of scientific action in which researchers present and discuss their research and their results. There are no clear rules for conducting an SE [7, 13]. They are usually determined by the organizing committee of SA. There are only some guidelines that are determined by the criteria for inclusion in the Plan of conducting an SA of the Ministry of Education and Science of Ukraine [14, 15]. In particular [15, 16], in an international conference, as a rule, there should be at least five participating countries, and the number of participants should be more than one hundred people.

SE is an important channel for the exchange of oral information between scientists, as well as the publication of a written report on the study presented at the SE [2]. It is very important that, as a rule,

the SE is important not only for the scientists who take part in it but also for the scientific organization to which these scientists belong and under the auspices to which the SE is conducted.

This affects the ratings of the organization, the popular indices of influence of scientists and the organization as a whole, and so on.

A number of requirements are a prerequisite for the publication of SA materials and their indexing in Scopus and/or WoS. To transform SA into SE, it is advisable to formulate some requirements that are a necessary prerequisite for determining the rating of SE:

- SA policy: editorial policy, review policy, geographical representation of the program committee, the geographical diversity of SA participants;
- content and scientific weight of SA materials;
- authority of SA: citation of the participants of SA in Scopus and/or WoS, the authority of the editorial board and members of the SA Program Committee, number of publications in the DBLP database, etc.;
- he number of years during which SA is organized and becomes SE;
- the language of SA, which contributes to its international recognition;
- the quality of the SA site, the quality of the SA materials, etc.

It should be noted that the provision of the necessary conditions for the SA conducting should be comprehensive, all the details and tasks should be provided to prevent a situation that could hinder success. In particular, the abuse or neglect of publishing ethics is unacceptable and, of course, is also a necessary condition for the transformation of SA into SE.

3. Statement of the problem

In order to orient in the scientific space, to organize and substantiate the assessment of the SE, as well as to adequately determine the significance of the SE, it is necessary to choose parameters that fully and adequately characterize the conducting of the SA. In addition, it is necessary to propose a uniform scale for measuring SE.

It is clear that the analysis of this information should be preceded by recognition of open data contained on relevant sites, scientometric databases, etc. that is names of authors, the affiliation of authors with scientific organizations, links to publications of authors of relevant organizations, recognition of related attributes, searches for related information, etc.

Let's assume that the number of SA that should be compared and/or determined their integral effectiveness (efficiency, usefulness, importance, status, weight, quality, significance) in the context of the interests of the organization, is equal to n and the set of their indices is $J = \{1,...,n\}$.

The problem of determining the effectiveness of the SE should be divided into several stages, which give SA the status of SE and affect the level of integrated quality of the SE:

1. Defining the policy of organization and conduct of SA.
2. Making a decision on the preparation and publication of SA materials.
3. Determining quantitative indicators of the effectiveness of SE in terms of the interests of the organization.

In order to prepare a mathematical model to determine the effectiveness of SE, we consider a set of attributes of SA $z_i^j, i \in I = \{1,...,k\}, j \in J$, which can be used to determine quantitative indicators of SE effectiveness and used to compare the effectiveness of different SE.

4. Approaches to determining the quality of a scientific event

As noted above, in the context of the problem publishing the next issue of the scientific journal and its indexing by scientometric databases are also SE. Therefore, the approaches used by Scopus and WoS to determine the level of scientific journals can also be applied to identify the integrated quality of SE.

Approaches to determining the quality of a scientific event may be similar to determining the impact factor of scientific journals. But, unlike journals, there is much more diversity among SA. In addition, they are not regular and periodic. They are usually one-off or annually.

At the same time, by analogy, we can consider the publishing of the next issue of the scientific journal as SE. By applying the approach described in this paper, we can also determine the effectiveness of each issue of the journal for the organization. Prerequisite for the application of this approach is to ensure preliminary text recognition [17, 18]: names of authors, affiliation of authors, search for affiliated with organization authors among the cited literature, definition of indexing in Scopus and/or WoS links presented in the article [19, 20], etc.

Ensuring an appropriate definition of the integrated quality indicator of the SE holding requires the construction of an adequate model for relevant and sustainable evaluation of the effectiveness of the SE.

Stage I. Carrying out expert assessments of some parameters and limits of SE attributes change.

Stage II. Introduction of a dynamic approach to determining the quality of SE, clarification of parameter values and limits of attributes change.

Stage III. Application of a static approach to determining the quality of SE based on the analysis of the SE database: when filling the database with information is sufficient.

4.1. Expert approach

Attributes and intervals for changing parameters of the model are set by experts. All volumes of SE materials that are subject to indexing by scientometric databases can be considered as interdependent in some way. This is due to the fact that all SE materials are included in a higher level system that is the world scientometric database. In addition, the level of efficiency of the SE is a relative value and is determined on the basis of comparison with other SEs. In particular, significant parameters are selected by experts [21, 22]. At the stage of expert approach preference vectors, weights of parameters, ranking of objects, coefficients of competence of information sources [23, 24], etc. can be determined in different ways [25, 26].

4.2. Dynamic approach

When applying this approach, the attributes and intervals of the values of the SE characteristics change as the database is filled. Such changes and clarifications must be made in accordance with the regulations and may not be permanent. It is necessary to clearly define the time, circumstances, and criteria for both the implementation of changes and the limits of their change and the actions that accompany these changes.

In this case, a methodological question arises: do we need to list the values obtained in the initial stages of the automated system processing for determining the intervals of parameters change, or leave them as obtained at the beginning of the calculation? The answer to this question may be the introduction of appropriate heuristics to ensure certainty and unambiguity.

Note that the resulting level (integral index) of SE quality can be determined on different scales [21, 27]. The representation of the SE effectiveness index can be given by a fixed number, as an interval or as a function of belonging to a fuzzy set. In turn, these types of integrated effectiveness index of SE can be measured in different specified ranges [28, 29].

4.3. Static approach

If the SE database is sufficiently full, a static approach can be used to determine the effectiveness of SE. In this case, the values of the parameters of the mathematical model and the limits of the SE attributes remain unchanged for different decision-making situations. In this case, all the limits of the intervals of changing parameters are fixed and do not affect the mathematical model adopted to determine the quality of SE.

In cases when the static approach is not effective enough, comments and suggestions are accumulated, new versions of the statically accumulated database and the system of formalization of SE as a whole are created [30, 31].

5. Mathematical model for determining the policy of organizing and conducting a scientific event

We can consider several evaluation options when it is not possible to select a standard:

- measurements in absolute values;
- comparison of priority options with each other and formalization of the choice in the form of a matrix of pairwise comparisons, ranking in the ordinal scale [32] or the vector of weight coefficients in the cardinal scale [33];
- comparison of each variant with a set of variants, if the characteristics of this set, distribution of values, etc. are known.

Three stages of decision-making are considered:

1. A priori definition of SE policy.
2. Making a decision on the preparation and publication of materials for SE.
3. Preparation for the decision to accept the article for publication and determination of quantitative indicators of the SE effectiveness in terms of interests of the organization.

In determining the indicators of the SA participants, the Program Committee, the Organizing Committee should take into account, in particular, their representation in the database DBLP that is the site of the bibliography of computer science at the University of Trier in Germany [34]. This service accumulates and provides open bibliographic information on the materials of the main SEs.

To formalize SA and weigh the quality of SE, we assume that in order to study this area it is considered n SE, which form a set of indices $I = \{1,...,n\}$.

5.1. A priori definition of the policy of the scientific event

A priori constraints, according to the policy of the scientometric base or another resource, are a necessary condition for the transformation of SA into SE. In addition, at the first stage, the Program Committee of SA should determine the target values of the parameters:

z_1^{1i} – representation of the countries of the world among the members of the Program Committee - the number of represented countries, $i \in I$;

z_2^{1i} – the relative number of foreign members of the SA Program Committee, $i \in I$;

z_3^{1i} – geography of the countries represented in the Program Committee, $i \in I$;

z_4^{1i} – average DBLP index of the Program Committee, $i \in I$;

z_5^{1i} – lower limits on DBLP indexes of author, $i \in I$;

z_6^{1i} – use tools like EasyChair or traditional email, $i \in I$;

z_7^{1i} – official languages of the conference, $i \in I$;

z_8^{1i} – expert assessment of the quality of SA site, $i \in I$;

z_9^{1i} – expert assessment of the importance of these factors, $i \in I$.

5.2. Making a decision on the preparation and publication of materials for a scientific action

The main parameters of the second stage are:

z_1^{2i} – number of foreign authors, $i \in I$;

z_2^{2i} – average DBLP index of the authors of the event, $i \in I$;

z_3^{2i} – limit on the number of citations, $i \in I$;

z_4^{2i} – the allowable number of citations of Ukrainian authors, $i \in I$;

z_5^{2i} – lower limits on DBLP indexes of author, $i \in I$;

z_6^{2i} – allowable number of self-citations, $i \in I$;

z_7^{2i} – allowable number of mutual citations, $i \in I$;

z_8^{2i} – the number of reports submitted to SE, $i \in I$;

z_9^{2i} – the number of reports accepted at SE, $i \in I$;

z_{10}^{2i} – the ratio of accepted/rejected reports, $i \in I$;

z_{11}^{2i} – the presence of a positive history of publishing and indexing in scientometric databases, $i \in I$.

5.3. Making a decision on the acceptance of articles for publication and determination of quantitative indicators of the effectiveness of SE in terms of the interests of the organization

The parameters of the third stage include:

z_1^{3i} – the number of articles of the affiliated organization, $i \in I$;

z_2^{3i} – the number of authors of the affiliated organization, $i \in I$;

z_3^{3i} – the total number of published pages of SE materials by the authors of the affiliated organization, $i \in I$;

z_4^{3i} – the average number of pages per article in the SE materials, $i \in I$;

z_5^{3i} – the number of mutual citations of the authors of the affiliated organization among the SE materials, $i \in I$.

5.4. Formalization of the problem

The tasks of effectiveness determining of SE will be formalized in the class of problems of multicriteria optimization. Herewith, given the need to use heuristics in such cases, we will pay considerable attention to the subjective component of multicriteria problems.

Note that today there are three main approaches to describing the problems of introspective (internal, deep) analysis: using binary relations, the function of choice and the criterion approach. The latter approach involves the assumption that each alternative can be evaluated by a specific number, which is the value of the criterion, so the comparison of alternatives is reduced to comparing the corresponding numbers. It becomes obvious that in the practice, multicriteria is a way to increase the goal description adequacy [33, 35, 36].

Let us $f_1(z)$ is the function of the quality of preparation and conducting of SE, and $f_2(z)$ is the function that reflects the risks of non-publication of SE materials and, accordingly, the impossibility of considering it as a scientific event. In this case, in the second stage of solving the problem of the effectiveness of the SE the decision-maker must solve at least a two-criteria problem.

The problem of multicriteria optimization for the case of determining the quality of the SE is formalized in the following formulation:

$f_1(z) \to \max,$

$f_2(z) \to \min,$

$z \in A, \;\; A \subseteq E^k,$

where A is the range of allowable values of quality indicators of SE, which are limited by the requirements of scientometric databases to scientific publications and are characterized in our case by two parameters, that is belong to the space E^2;

$y(z) = (f_1(z), f_2(z))$ is the vector of assessment of alternatives or criteria determined by the mapping $f : A \to E^2$.

Additional heuristics can be introduced to determine the problem.

Heuristics E1. The minimum participation of the author in SE is one publication, zero citations of own articles and zero mutual citations.

Heuristics E2. The maximum participation of the author in SE is a function of the maximum possible number of publications and a function of the maximum possible number of self-citations and mutual citations. Moreover, these indicators are determined expertly or statistically.

The use of heuristics E1 and E2 allows to supplement the mathematical model and adequately apply the monotonic functions of transformations of the values of the model parameters to the dimensionless form.

6. Tools for determining the effectiveness of SE holding.

To determine the quantitative indicators of the effectiveness of SE holding, all the values of the parameters $z_i^i, i \in I = \{1,...,k\}, j \in J = \{1,...,n\}$ are translated into dimensionless space by applying monotonic transformations: $\omega_i^j = \omega(z_i^i), i \in I = \{1,...,k\}, j \in J$.

Methods of processing expert information are divided into three main groups, which are currently well researched and adequately reflect the nature of expert information:

- statistical methods,
- scaling methods,
- algebraic methods.

The essence of algebraic methods is that the distance is given on the set of acceptable estimates and the resulting estimate is defined as such, the distance of which to the given estimates is minimal by a certain selected criterion [33, 37].

When solving the problem of comparing the quality of SE special attention should be paid to the aggregation of group estimates. One of the widespread tasks of expert assessment is the choice in a fixed in advance class of relations of some resulting (compromise, group, collective) relation, which is consistent with the given in some way. It is possible to construct a convolution (generalized, aggregating, integral criterion of quality of an alternative) in many ways and this procedure necessarily includes an element of subjectivity. The convolution method should be justified only to the extent that the complete order generated by the convolution must be consistent with the given partial order. There are known dozens of methods of aggregation, some of which can be used to solve the problem of aggregation of indicators of integrated quality of SE [37, 38].

6.1. Aggregation of the effectiveness of the SE holding

The lessons learned of expert estimation in numerous fields of human activity shows that any statistical operations become more useful and justified if the number of features used for analysis is reduced. Therefore, the problem of aggregating the features that characterize SE to a smaller number of constructed "factors" (aspects, etc.) occupies a significant place in the tasks of the effectiveness determining of scientific activities. The analysis of the set of SE estimates by group of parameters is to determine the level of overall consistency of SE estimates and to identify, if necessary, in the group a "homogeneous" subgroups that combine SE parameters with agreed estimates. The formulation of these problems is dictated by the fact that the transition to the aggregation of estimates for different parameters is possible only after identifying the structure of preferences. For example, if the overall

consistency of estimates by parameters is low and the group of parameters is divided into several subgroups, within which the consistency of estimates is high, then aggregation should be performed for these subgroups by estimates of parameters.

In the analysis of SE quality estimates and in determining the relative importance of SE publications, there are problems of presenting these estimates in a systematic way, there are problems of comparison and aggregation of estimates. The usage of mathematical methods in the analysis of expert assessments permits to adequately sum up the conclusions of specialists and identify the information they have in hidden form [38, 39].

6.2. Types of convolutions

Most often on the basis of several conflicting indicators of n SA, "convolution" (aggregation, integration, generalization, etc.) of indicators with indices $i \in I = \{1,...,k\}$ of each SA in some single integrated indicator $Q_j = Q\left(z_1^j,..., z_k^j\right),\ j \in J$, is carried out.

To construct a convolution denotes to expand the partial order on the set of SE estimates to the complete one [33, 37]. This can be done in many mechanisms, and necessarily includes an element of subjectivity [40]. In this regard, it is sometimes believed that the convolution method should be justified only to the extent that the complete order generated by the convolution must be consistent with the natural partial order.

The subset of indicators that are essential for determining the integrated rating of SE is selected from the general set of indicators, for example, expertly.

Among the most common are the following families of convolutions, adapted to a 100-point scale:

- linear convolution

$$Q_j^{(1)} = \left(1 - \sum_{i \in I} \rho_i \omega_i^j\right) * 100\ ,\ j \in J\ , \tag{1}$$

- multiplicative convolution

$$Q_j^{(2)} = \left(1 - \prod_{i \in I} \rho_i \omega_i^j\right) * 100\ ,\ j \in J\ , \tag{2}$$

- generalized convolution of indicators, which is also called the principle of "bottleneck"

$$Q_j^{(3)} = \left(\max_{i \in I}\ \rho_i \omega_i^j \Big/ \max_{i \in I}\ \rho_i\right) * 100\ ,\ j \in J\ , \tag{3}$$

- nonlinear convolution using quadratic metrics

$$Q_j^{(4)} = \left(1 - \sqrt{\sum_{i=1}^{n} \rho_i \omega_i^{\,2}}\right) * 100, j \in J\ , \tag{4}$$

where $\omega_i^j = \omega_i^j\left(z_i^j\right),\ i \in I\ ,\ j \in J$, are the normalized values of the parameters of SE z_i^j, $i \in I$, $j \in J$, defined by monotonic transformations;

$\rho_i,\ i \in I$, are the weight coefficients of the parameters by which the SEs are estimated.

The approaches described in formulas (1) to (4) reflect the definition of the distance to an ideal point. In the case of calculating the integral quality of SE, the ideal point is a point with parameters $\omega_i = 0,\ \forall i \in I.$

It is also advisable to use additive convolution to determine the integrated rating value of SE:

$$Q_j^{(5)} = \sum_{i \in I} \rho_i z_i^j \Big/ \sum_{i \in I} \rho_i \left(\max_{j \in J}\ z_i^j - \min_{j \in J}\ z_i^j\right) * 100\ ,\ j \in J\ , \tag{5}$$

In addition to formulas (1) - (5), other types of convolutions can be used and substantiated to determine the numerical value of the integral quality of SE.

When determining the values of the parameters that characterize the effectiveness of SE, it is also necessary to determine the methods of aggregation and consideration of these indicators. Several approaches can be used:

- averaging the values of parameters of all authors who are included in the published materials of SE;
- combining the values of the parameters of all articles of SE of the organization affiliated to the scientometric database;
- synergetic approach, for example, the value of the h-index of the affiliated organization (for its unambiguous comparison with other organizations).

7. Computational experiment

Based on the proposed approaches to determining the integrated indicator (index) of SE quality, several scientific conferences were considered, the materials of which were published in the international open access archive CEUR Workshop Proceedings.

According to the concept set out in this paper, the importance of these SEs was considered taking into account the interests of a particular institution - Taras Shevchenko National University of Kyiv. Additional heuristics should be used.

Heuristics E3. Any participation of a scientist affiliated with the organization in SA is a significant event and can be taken into account when calculating the rating of SE.

Heuristics E4. All parameters are significant and their weight is determined adequately. For this purpose, procedures for restoring the values of weight coefficients may be proposed depending on the subjective preferences of the decision-maker.

Since the software of the mathematical support of the problem of determining the integral quality of SE described in this paper is at the stage of implementation, it is logical to use an expert approach to calculate the values of indices of integrated quality of SE. In addition to the heuristics E3 and E4, we assume that the maximum possible number of scientific publications of authors affiliated with one organization is 30, and the number of authors is 50. The maximum number of references to literature the authors of which affiliated with this organization is 100, and the maximum number of DBLP indexes increased as a result of SE is 50.

We present the intervals of change of parameters and coefficients of their importance for decision making in the form of Table 1.

Table 1

Intervals of change and weight coefficients of parameters

Parameter name	Minimum value	Maximum value	Weight coefficient
Number of Papers	0	30	0,1
Number of Authors	0	50	0,1
Number of Citations	0	100	0,5
Index DBLP	0	50	0,3

We present some basic situations of decision-making and the values of the parameters near the basic situations in the form of Table 2.

Table 2

Values of parameters that characterize the basic situations of decision making

Parameter name	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7
Number of Paper	30	0	1	1	0	0	0
Number of Authors	50	0	1	0	1	0	0
Number of Citations	100	0	1	0	0	1	0
Index DBLP	50	0	1	0	0	0	1

Let's calculate the values of the criterion functions near the basic situations and present them in the form of Table 3.

Table 3
The value of criteria near basic situations of decision-making

Criterion name	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7
Linear convolution of a form (1)	100	0	1,63	0,33	0,2	0,5	0,6
Multiplicative convolution of a form (2)	100	0	8,09	3,33	2	1	2
Generalized convolution of a form (3)	100	0	1,2	0,67	0,4	1	1,2
Quadratic convolution of a form (4)	100	0	1,63	0,33	0,2	0,5	0,6
Additive convolution of a form (5)	100	0	1,37	0,14	0,14	0,68	0,41

Table 3 illustrates that in basic situations, the values of all individual functions are acceptable and reflect the content load that was expected to determine the number of values of SE.

To conduct a computational experiment, we take six real SE, which are presented in the international archive CEUR and present the values of the main parameters of the selected experiments, in the form of table 4.

Table 4
The values of the parameters that characterize SE, selected from CEUR

Parameter name	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6
Number of Paper	3	3	2	14	3	5
Number of Authors	5	4	5	21	7	12
Number of Citations	0	0	9	51	13	8
Index DBLP	0	0	5	18	0	12

Consider the values of the criterion functions of the form (1) - (5), which describe the ratings ofSE, at the points whose coordinates are given in table 4. These values are presented in the form of a table 5.

Table 5
The values of the parameters that characterize SE, selected from CEUR

Criterion name	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6
Linear convolution of a form (1)	2	1,8	9,17	45,17	8,9	15,27
Multiplicative convolution of a form (2)	19	17,2	31,2	90,3	32,66	55,72
Generalized convolution of a form (3)	2	2	9	51	13	14,4
Quadratic convolution of a form (4)	1,92	1,73	9,16	44,77	8,71	14,93
Additive convolution of a form (5)	1,1	0,96	9,18	47,12	10,27	12,74

It should be noted that the final decision, namely which metric among formulas (1) - (5) should be used for numerical determination of the integral significance of SE, as always, is made by the decision maker. Because these formulas reflect different approaches to determining the significance of SE. Criteria for such a choice may be, for example, which metric is more sensitive, adequate from the point of view of the decision-maker, and so on.

It is clear that the problem of determining the weights of parameters, the development of adaptive decision-making procedures require further study. In particular, based on which of the metric graphs presented in Table 5 is the closest to the subjective perception of the decision-maker about the rating of SE depending on the achieved indicators.

8. Conclusion

In this paper the techniques to research of efficiency of SE are investigated. The authors assumed that the consequence of scientific research is a publication that confirms the fact of scientific achievement, with which the scientist will be able to acquaint not only his colleagues but also the world community. The scientific work is not completed until it is published and indexed in a scientometric database. In the modern scientific world, publishing activity is becoming increasingly important for every scientist, regardless of the scope of his research, and the scientific organization or the university as a whole.

The following main scientific results were obtained:

- theoretical investigation of the problem of creating a system of assessment and control of effectiveness (efficiency, quality, significance) of the SE is carried out;
- the role of the individual component in the decision support system for assessment the integrated quality of research materials is studied;
- techniques to measuring qualimetric indicators of effectiveness of research is developed;
- criteria of assessment the quality and effectiveness of scientific activities are explained;
- approaches to determining the ratings of SEs are proposed, taking into account the need to motivate employees of organizations;
- interpretation of integral effectiveness of SE is offered and substantiated;
- a computational experiment on real data on published SE materials for a specific scientific organization is conducted.

In the perspective of conducting research in this scope, it is advisable to automate and implement in the form of DSS tool for automated retrieval of information from the scientometric database and create software for quality analysis of conducting of SE.

References

[1] Simonov P.V. Selected works: In 2 vols. Vol. 1. Brain, emotions, needs, behavior. - M.: Nauka, 2004. – P. 396.

[2] Kulamer B., Meester W., Salk J., Blair-DeLeon N., MacPherson G., Moses W., Philippidis A., Chapman C., Smith D., Stoneham I., Vukmirovic K. Recommended Practices to Ensure Technical Conference Content Quality // 4th World Conference on Research Integrity Rio De Janeiro, Brazil, June 2, 2015. URL: https://www.ieee.org/conferences_events/conferences/publishing/paper_acceptance_criteria.pdf

[3] Moed H., Glanzel W., Schmoch U. Handbook of Quantitative Science and Technology Research. Springer Netherlands. 2004. 800 p. ISBN 978-1-4020-2755-0.

[4] Ying Ding. Scientific collaboration and endorsement: Network analysis of coauthorship and citation networks. Journal of Informetrics. 2011. 5 (1). C. 187 – 203. doi: 10.1016/j.joi.2010.10.008

[5] Biloshchytskyi A., Myronov O., Reznik R., Kuchansky A., Andrashko Yu., Paliy S., et al. A method to evaluate the scientific activity quality of HEIs based on a scientometric subjects

presentation model. Eastern-European Journal of Enterprise Technologies. 2017. Vol. 6, Issue 2 (90). – P. 16–2 2. doi: 10.15587/1729-4061.2017.118377
[6] Kuchansky, Alexander. (2020). Components of scientific network analysis. Management of development of complex systems, 41, 115–126, dx.doi.org\10.32347/2412-9933.2020.41.115-126
[7] Recommendations on how to organize scientific and methodological and initial seminars / Ed.-style: E.M. Bachinska, N.I. Klokar, V.I. Urus. - Bila Church - Ternopil, 2004. - 48 p.
[8] Rach V.A. Methodology of the systemic approach and scientific reports: Heading guide / V.A. Rach, O.V. Ignatov. – Luhansk: type of SNU im. V.Dalya, 2010. – 210 p.
[9] Biryukov O. V. Scientific and communicative approach and approbation of scientific results: nomination, recognition, recognition / O. V. Biryukov, V. V. Zelenska, N. O. Zakharova // Project management and development of virobnitstva. – 2017. – No. 3. – Pp. 76-96. – Access mode: http://nbuv.gov.ua/UJRN/Uprv_2017_3_6
[10] Birta G.O. Methodology and organization of scientific research. [text]: textbook way. / G. O. Birta, Yu.G. Burgu – K .: Center for Educational Literature, 2014. – 142 p.
[11] Robert Day, Barbara Gastel. How to Write and Publish a Scientific Paper. Cambridge: Cambridge University Press, 2012. – P.9.
[12] Richard Van Noorden. Publishers withdraw more than 120 gibberish papers // Nature. – doi:10.1038/nature.2014.14763.
[13] Cyril Labbé. Ike Antkare one of the great stars in the scientific firmament (англ.) // International Society for Scientometrics and Informetrics Newsletter. – 2010. – June (vol. 6, no. 2). – P. 48-52.
[14] Instructional recommendations on proposals from higher education institutions for the formation of the Plan of the Ministry of Education and Science of Ukraine for international, national scientific and practical conferences and seminars of young scientists and students // Supplement to the letter of the Ministry of Education and Science of Ukraine 28.09.2009 №1 / 9-662.
[15] Instructional recommendations on the organization and conduct of international, all-Ukrainian scientific-practical conferences and seminars of students and young scientists // Supplement to the letter of the Ministry of Education and Science of Ukraine 19.09.2013 № 1 / 9-649.
[16] On holding international, all-Ukrainian congresses, forums, scientific and practical conferences and seminars of students and young scientists for 2016 // Letter of the Ministry of Education and Science of Ukraine 14.09.2015 № 1 / 9-435.
[17] Grant S. Ingersoll, Thomas S. Morton, Andrew L. Farris. Taming text: how to find, organise, and manipulate it / Shelter Island, NY : Manning. 2013. 298p.
[18] Hillary Mason. The Next Generation of Data Products (2017). http://bit.ly/2GOF894
[19] Rebecca Bilbro, Tony Ojeda, Benjamin Bengfort. Applied Text Analysis with Python: Enabling Language-Aware Data Products with Machine Learning / O'Reilly Media, Incorporated, 2018. – 332p.
[20] Lane Hobson, Howard Cole, Hapke Hannes Max. Natural Language Processing in Action: Understanding, analyzing, and generating text with Python/Manning Publications, 2019. – 544 p.
[21] Elkind, E. Distance rationalization of voting rules / E. Elkind, P. Faliszewski, A. Slinko. // Social Choice and Welfare. — 2015. — Vol. 45, No. 2. — Pp. 345–377.
[22] D'Ambrosio, A. Kemeny's axiomatic approach to end consensus ranking in tourist satisfaction / A. D'Ambrosio, V.A. Tutore. // Statistica Applicata. — 2008. — Vol. 20, No. 1. — Pp. 21–32.
[23] Bury, H. Zastosowanie mediany Litvaka do wyznaczania oceny grupowej w przypadku występowania obiektów równoważnych / H. Bury, D. Wagner. // Studia i Materiały Polskiego Stowarzyszenia Zarządzania Wiedzą. — 2007. — Vol. 10. — Pp. 19–34.
[24] List, C. Judgement aggregation: a survey / C. List, C. Puppe. // In: Oxford handbook of rational and social choice. — Oxford: Oxford University Press. — 2009. — Pp. 457–482.
[25] Bury, H. Group Judgement With Ties. Distance-Based Methods / H. Bury, D. Vagner. // In: H. Aschemann (ed.). New Approaches in Automation and Robotics. — Vienna: I-Tech I-Tech Education and Publishing. — 2008. — Pp. 153–172.
[26] Cook, W.D. Distance-based and adhoc consensus models in ordinal preference ranking. / W.D. Cook. // European Journal of Operational Research. — 2006. — No. 172. — Pp. 369–385.

[27] Hudry, O. Complexity of computing median linear orders and variants / O. Hungry. // Electronic Notes in Discrete Mathematics. — 2013. — Vol. 42. — Pp. 57–64.
[28] Amodio, S. Accurate algorithms for identifying the median ranking when dealing with weak and partial rankings under the Kemeny axiomatic approach // S. Amodio, A. D'Ambrosio, R. Siciliano. // European Journal of Operational Research. — 2015. — No. 249. — Pp. 667–676.
[29] Alnur, A. Experiments with Kemeny Ranking: What Works When? / A. Alnur, M. Meila. // Mathematical Social Sciences. — 2012. — Vol. 64, No. 1. — Pp. 28-40.
[30] A. Dodonov, D. Lande, V. Tsyganok, O. Andriichuk, S. Kadenko, A. Graivoronskaya (2019). Information Operations Recognition. From Nonlinear Analysis to Decision-Making, Lambert Academic Publishing, 2019, 275 p.
[31] Hnatiienko H., Tmienova N., Kruglov A. (2021) Methods for Determining the Group Ranking of Alternatives for Incomplete Expert Rankings. In: Shkarlet S., Morozov A., Palagin A. (eds) Mathematical Modeling and Simulation of Systems (MODS'2020). MODS 2020. Advances in Intelligent Systems and Computing, vol 1265. Springer, Cham. https://doi.org/10.1007/978-3-030-58124-4_21. Pp. 217-226.
[32] Hnatiienko H., Snytyuk V. A posteriori determination of expert competence under uncertainty / Selected Papers of the XIX International Scientific and Practical Conference "Information Technologies and Security" (ITS 2019), pp. 82–99 (2019).
[33] Voloshin, A.F., Gnatenko, G.N., Drobot, E.V. The method for indirect determination of intervals of weight coefficients of parameters for metrized relations between objects(Article) // Problemy Upravleniya I Informatiki (Avtomatika)Issue 2, 2003, Pages 34-41.
[34] Ley, Michael. Maintaining an Online Bibliographical Database: the Problem of Data Quality // EGC, ser. Revue des Nouvelles Technologies de l'Information: journal. – 2006. – Vol. RNTI–E–6. – Pp. 5-10.
[35] M. Rakushev,Y. Kravchenko, O. Permiakov, O. Lavrinchuk,V. Bychenkov, V Krainov, “Modeling of solving stabilized differential equations by differential-Taylor transformations”, IEEE 2nd International Conference on Advanced Trends in Information Theory, ATIT`2020, Proceedings, pp. 216–221.
[36] Hnatiienko H. Choice Manipulation in Multicriteria Optimization Problems / Selected Papers of the XIX International Scientific and Practical Conference "Information Technologies and Security" (ITS 2019), pp. 234–245 (2019).
[37] Hnatiienko, H., Snytyuk, V., Tmienova, N., Voloshyn, O. Determining the effectiveness of scientific research of universities staff / CEUR Workshop Proceedings, Volume 2833, 2021, Pages 164-176 // 7th International Conference ""Information Technology and Interactions"", IT and I 2020; Kyiv; Ukraine; 2 December 2020 through 3 December 2020; Code 167962
[38] Hnatiienko, H., Kudin, V., Onyshchenko, A., Snytyuk, V. and Kruhlov, A. Greenhouse Gas Emission Determination Based on the Pseudo-Base Matrix Method for Environmental Pollution Quotas Between Countries Allocation Problem / 2020 IEEE 2nd International Conference on System Analysis & Intelligent Computing (SAIC), Kyiv, Ukraine, 2020, pp. 150-157, doi: 10.1109/SAIC51296.2020.9239125.
[39] Hnatiienko H.M., Snytyuk V.Y., Suprun O.O. Application of Decision-Making Methods for Evaluation of Complex Information System Functioning Quality // Selected Papers of the XVIII International Scientific and Practical Conference "Information Technologies and Security" (ITS 2018). Kyiv, Ukraine, November 27, 2018. Pp.56-65.
[40] Kraevsky, V., Kostenko, O., Kalivoshko, O., Kiktev, N., Lyutyy, I. Financial Infrastructure of Telecommunication Space: Accounting Information Attributive of Syntalytical Submission / IEEE International Scientific-Practical Conference Problems of Infocommunications, Science and Technology (PIC S&T). DOI: 10.1109/PICST47496.2019.9061494.