

# The Content Creating of the Scientific Knowledge Digital Space <sup>1</sup>

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**Abstract.** The paper proposes the formation problem of the Common Digital Space of Scientific Knowledge (CDSSK) content. The CDSSK is a computer environment, where the user should get exhaustive answers to questions concerning the achievements in various fields of science. The CDSSK should contain both basic and popular-scientific information and consist of a subspaces related to the different science fields. Its content should include factual data, source link where they are from, and these sources full texts. One of the major challenges in the formation of CDSSK is the selection of materials to be included in its content. One of the solutions to this problem is expert assessment, which should be carried out by a fairly wide range of highly qualified specialists in this field of science. This paper describes the expert WEB-based selection material system for inclusion in the CDSSK. This system was carried out by the Joint Supercomputer Centre of the Russian Academy of Sciences in 2019. The structure of the system, its functions, metadata profiles included in it, and the results of practical implementation are given in the paper. The system was tested at two all-Russian competitions – for the best scientific monograph and for the best student qualification work. Several hundred works were submitted to the competitions, and several dozen experts from various regions of the country participated in their evaluation.

**Keywords:** Common Digital Space of Scientific Knowledge, Expert Assessments, Automated System, WEB Technologies, Metadata, Electronic Libraries, Content Generation.

## 1 Introduction

The problem of selecting materials for inclusion in databases, electronic libraries and other information systems is one of the most important in the formation of such resources. It is extremely important when forming the content of a common digital space of scientific knowledge (CDSSK). CDSSK is a computer environment, where

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the user should get exhaustive answers to questions concerning the achievements in various fields of science. This environment should contain the true basic and popular-scientific information represented as different object types such as encyclopedic articles, factographic databases, some phenomena digital models, archival, museum and library storage materials, presented in the form of digitized texts, images, and multimedia resources.

The CDSSK consists of a number of subspaces complex related to separate scientific disciplines, each of which reflects its own specifics and has its own subject ontology, built on the same principles for all subspaces. The join ontology provides the connection between subspaces [1, 2].

Despite each subspace specifics, all of them must have a documentary component, including full document texts that record scientific results. It is based on monographs, reference books and textbooks that reflect generally recognized, time-tested scientific knowledge, and are "classic" for each science field. It is clear that in any scientific field there is a significant number of classical works, many of which duplicate each other. In this connection there is the selection problem of the most important classical publications for inclusion of their full texts in CDSSK.

In addition to the time-tested publications, the CDSSK should contain new knowledge, which is also in scientific publications. The annual number of scientific publications appearing in the world (both in print and electronic forms) is the millions. As far as, by definition, the CDSSK should contain only reliable scientific information that is relating to knowledge, there is a selection problem of the most significant scientific publications which are the knowledge community, "worthy" for presenting to the CDSSK.

To solve these problems, the authors suggest to use an iterative process, which provides the first material choice with using certain objective indicators (the publishing prestige, citation, author's qualifications, etc.), followed by expert evaluation of pre-selected materials. The fairly wide range of highly qualified specialists must implement the expert assessment in this field of science.

As already pointed out, there are not only published materials but also various problem-oriented information systems in the CDSSK. The appreciable quantity of such systems is in many areas of both the natural and humanitarian sciences.

As [3] indicates, there are more than 1000 information systems in the history area; [4-6] describes the monitoring of Russian information resources in the social sciences area, the results of which are in the «NIRON» system, which contains data on more than three thousand resources of different types and different thematic focus. The website «Science in Runet» [7] reflects more than 10,000 information resources related to natural and exact sciences.

The organization of an expert community in various areas within a particular science field is a separate task that should be solved by the relevant structures that organize the work on the formation of the CDSSK subspaces. In particular, experts from the Russian Academy of Sciences, which is responsible for examining all scientific developments in the country, can act as the CDSSK experts.

It is obvious that the examination of materials, which are for showing in the CDSSK, is necessary to be in networking with the experts from different regions. It is also

necessary to develop a typical automated system that can be configured for different types of objects and for different assessment systems should be developed for conducting the examination. Such a system should contain a database of objects subject to examination and a database of experts. The result of its work is a rating list of objects, ordered in accordance with the received estimates, taking into account the possible "weights" of experts. The prototype of such a system can serve as the expert system of acquisition [8-11], developed with the participation of authors and has been operating successfully for many years in the Library for natural Sciences of Russian Academy of Sciences (LNS RAS) and Central scientific library of the Ural branch of RAS [12, 13]. The purpose of this system was to optimize acquisition - to identify the most informative new publications appearing on the book market, for each institution of the Russian Academy of Sciences, and then to order them for the collections of the library serving this institution, based on available financial resources.

Taking into account the experience gained in the operation of the expert acquisition system, the Joint Supercomputer Centre (JSCC) of RAS specialists worked out the "Expertise" system, its structure and functional features are below.

## **2 «Expertise» system structure**

The system includes two metadata databases (the expert database and the database of examination objects) and the object storage.

The expert metadata profile contains the following elements:

- the expert identifier;
- surname, name and patronymic;
- organization (the expert workplace);
- academic degree, membership in academies;
- subject areas of expertise (in terms of the subject area of the object metadata profile) with an indication of the "weight" of the assessment for each area/
- email address for correspondence with the expert;
- the individual login;
- the customized password to enter the system.

The metadata profile objects of expertise, generally speaking, depends on the specific valued objects (e.g., the publication metadata elements and factographic information system may be slightly different) and requirements to the object division into classes, within which to base rankings (e.g., a separate assessment of scientific monographs, popular scientific publications and textbooks presented in the same dataset will require inclusion in the metadata profile list on the publication type). The metadata profile of objects of expertise must include the following elements:

- the object name;
- short description;
- thematic scope;
- the object identifier in the storage;
- data about the copyright.

The storage of digital objects to be evaluated can be centralized (in this case, objects are uploaded to it from the outside), or it can be distributed (for example, publications stored in various external electronic libraries are evaluated). It is important that each object has its own unique identifier, which can be used to call it to the expert's computer screen. Objects can be text files, image files, or multimedia files. When an external information system is evaluated, the identifier included in its metadata profile should allow for versatile work with the system to form its multidimensional assessment.

On par with metadata describing experts and assessment objects, in the «Expert» system generates a number of overhead generic tables:

- a rating table containing verbal and numeric expressions;
- Thematic areas table;
- Academic degrees table;
- Table of organizations;
- User rights table.

The system provides for the work of various groups of users, each of which has its own rights. These groups include administrators, editors, experts, and managers. The administrator has the rights to configure the system, enter users and set their rights. The editor has rights to enter, view, and correct data. The expert has the right to view and evaluate objects. The Manager has the right to view the results of experts' work and create rating lists.

### **3 System functions**

The Expert system implements the following functions.

The system configuration by the administrator for specific metadata profiles, types of ratings, and user rights.

User authorization in accordance with the settings and providing opportunities to work with the system depending on their status.

The object and expert metadata batch loading from files of the specified structure (performed by the editor).

Manual loading of metadata using a special user interface that provides formal logical information control (performed by the editor).

Editing and deleting metadata (performed by the editor).

Search for objects by various metadata elements and their combinations using Boolean logic operators (performed by any user).

Visualization of found objects (available to any authorized user).

Input of object evaluations by experts who have the same thematic focus in their metadata as the object being evaluated.

Changes in experts' previous estimates.

Visualization of estimates given to each object by each of the experts (available to the Manager).

Calculation of total and average estimates of individual objects or their groups (available to the Manager).

Creating rating lists of objects within a given group (available to the Manager).

Output of calculation results to Excel files.

Automatic e-mailing of information to experts about the receipt of new objects that correspond to their thematic interests.

Data backup and recovery in case of failures.

In the process of operation, the system implements the "publication - expert – assessment" connections. Many experts can evaluate one publication; one expert can evaluate many publications; each expert can assign only one estimate to the publication.

The system is based on Microsoft technology ASP.NET 4 on the Microsoft .NET Framework in the Microsoft Visual Studio 2017 development environment.

#### **4 The system practical implementation example**

The system feature "Expertise" is the ability of its tenability to solve different problems. One of the classes of such problems is the tendering netting process. The system «Expert» modification, called "Competition", was of use in 2019 to conduct competitions for the best scientific monograph and the best qualifying student work, organized by the publishing house "Direct-Media "(PH DM) [14] in 12 scientific areas (see Fig. 1). The competition for the best monograph was in the categories «fundamental scientific book» and «popular science book». Competition of student papers - in the categories «bachelor» and «master»

The full texts of the objects from both competitions are in the electronic library (EL) of the PH DM, each of them has its own ID - URL. Publication metadata was loaded at the «Competition» system in batch mode from Excel tables exported from the electronic library of the PH DM.

As far as a number of experts evaluated papers for both competitions, to avoid duplication, a single database of experts was being created, but in the profile of their metadata, there was an indication which competition (s) this expert evaluates.

A screenshot of the page for entering expert metadata is shown in Fig. 1. Since the expert system has a Russian-language interface, the translation of their text elements is given below the screenshots (here and below). The expert's academic degree and the science branches in which they specialize are from the tables of academic degrees and subject areas.

**Конкурс монографий**

**Ввод нового эксперта**

Фамилия имя отчество: Власова Светлана Александровна

Название организации: ИИИСИ РАН

Ученая степень: кандидат технических наук

E-mail: vlas.svetlana2013@yandex.ru

Логин: svlasova

Пароль: \*\*\*

Дополнительная информация:

Эксперт конкурса:  ДА  НЕТ

**Выберите разделы науки, интересующие эксперта**

Биологические науки

Информационные технологии

История

Науки о Земле

Общественные науки

Право

Технические науки

Физико-математические науки

Филология

Философия

Химические науки

Экономика

Ввод

«Monographs» competition	
Entering a new expert	
Surname, name and patronymic	Vlasova Svetlana Aleksanrovna
Organization (the expert workplace)	JSCC RAS
Academic degree	candidate of technical Sciences
E-mail address	vlas.svetlana2013@yandex.ru
Login	svlasova
Password	***
Related information	
The competition expert	Yes
	No
Select the science sections that the expert is interested in	
Biological science	
Informatics	
History	
Earth Sciences	
Social Sciences	
Law	
Technical Sciences	
Physical and Mathematical Sciences	
Philology	
Philosophy	
Chemical Sciences	
Economics	
Enter	

**Fig. 1.** Interface for entering an expert

The «Competition» system allows to make an advanced search for experts in the following search fields:

- The expert full name;
- The organization's fragment name;
- Degree;
- e-mail address' fragment;
- Science sections;

- Competition expert (Yes/no).

Search terms are being input in one or more fields. The «academic degree» values and "science sections" fields the users select from drop-down lists. When you enter terms in multiple fields, they will be linked by the logical operator «And». In fig. 2 there is an example of searching for records registered in the experts' system that have a candidate's degree in Economics and are experts in the «Monographs» competition.



«Monographs» competition	
<b>Experts' searching</b>	
<i>Surname, name</i>	
<i>Organization (the expert workplace)</i>	
<i>Academic degree</i>	PhD in economics v
<i>E-mail address</i>	
<i>Science fields</i>	v
<i>The competition expert</i>	+Yes
	No
<b>ENTER</b>	
<b>Experts found: 8</b>	
Belov Aleksandr Grigorievich; Cheboksary cooperative Institute of the Russian University of Cooperation	
Vishnyakova Maria Nikolaevna; Kotlas branch of the Admiral Makarov state University of the sea and river fleet	
Mitrofanova Oksana Yurievna; SBEI APE «Institute of education development of the Sakhalin region»	
Osipova Alla Aleksandrovna; Far Eastern Federal University – RANEPА branch	
Teplaya Nina Vladimirovna; The All-Russian State University of Justice	
Shalotov Vasilij Vladimirovich; Adyge State University	

**Fig. 2.** Experts' searching example

In the list of experts obtained, their names and related organizations are active links. When you click on the selected link, the system shows the expert's metadata, which can be edited if necessary.

The rating tables for various contests had configurations by the system administrator to the lists set by the contest organizers (see Fig. 3).

During the examination, the system provides the expert with a list of available thematic areas in accordance with the specified area of thematic interests when registering. After selecting a focused area, the expert will be able to view the publication descriptions in the specified subject area. Under each publication description is a link to its full text, as well as a link to "Evaluate" (if the publication doesn't have an assessment by this expert). Clicking on the "Value" link allows the expert to select a rating from the list downloaded from the rating table and enter the necessary comment (see Fig. 3).

**Конкурс монографий**

Кондакова И.А., Левин В.И., Льгова И.П., Антошина О.А. «ТЕОРЕТИЧЕСКОЕ ОБОСНОВАНИЕ МЕРОПРИЯТИЙ ПО ПРОФИЛАКТИКЕ И БОРЬБЕ С МИКОТОКСИНАМИ, ВОЗНИКАЮЩИМИ В ПРОЦЕССЕ ЖИЗНЕДЕЯТЕЛЬНОСТИ МИКРОФЛОРЫ ЗЕРНОВОЙ МАССЫ»

**Выберите оценку**

Претендует на 1 место  
 Работа претендует на статус победителя  
 Включить в список лучших  
 Не представляет интереса  
 Следует исключить из конкурса

Комментарий

<b>«Monographs» competition</b>	
Kondakova I.A., Levin V.I., L'gova I.P., Antoshina O.A. «THEORETICAL JUSTIFICATION OF MEASURES FOR THE PREVENTION AND CONTROL OF MYCOTOXINS THAT OCCUR DURING THE LIFE OF THE GRAIN MASS MICROFLORA»	
<b>Select estimate</b>	
<i>Pretend the 1<sup>st</sup> place</i>	<input type="checkbox"/>
<i>The paper pretend to the winner status</i>	<input type="checkbox"/>
<i>Include to the list of the best</i>	<input type="checkbox"/>
<i>No interest</i>	<input type="checkbox"/>
<i>Should be excluded from the competition</i>	<input type="checkbox"/>
<i>Comment</i>	
<b>Enter</b>	

**Fig. 3.** Interface for evaluating publications

After selecting an estimate, the system returns to publication list in the corresponding thematic area, where the evaluated publication appears with the link "the Publication already has your estimate ". The expert can always change their estimate and comment by clicking on this link.

The system Manager access to the estimates issued by competition experts is given. After selecting a theme, the system will display descriptions of publications sorted in descending order of the total points received. Under the description of publications that have already been evaluated by at least one expert, there will be an average estimate, as well as a list of experts who have evaluated the publication, indicating the surname, first name and patronymic of the expert, his organization, the estimate and comment (see Fig. 4).



Конкурс монографий				
1 2 3 4		Выход	Главное меню	
Экономика. Всего записей: 74.				
1. "Волкова Н.В. " ИНСТИТУЦИОНАЛЬНАЯ ЭКОНОМИКА В ПРИМЕРАХ				
Средняя оценка: 5,00		Экспертов: 1		
<b>Организация</b>	<b>Эксперт</b>	<b>Оценка</b>	<b>Комментарий</b>	
Российский государственный университет правосудия Теплая Нина Владимировна		5 -	Претендует на 1 место	
2. "Рябченко А. В. " Организационно-экономический механизм функционирования интегрированных структур ракетно-космической промышленности				
Средняя оценка: 5,00		Экспертов: 1		
<b>Организация</b>	<b>Эксперт</b>	<b>Оценка</b>	<b>Комментарий</b>	
Всероссийский научно-исследовательский институт "Центр"	Мошин Андрей Юрьевич	5 -	Претендует на 1 место	
3. Василенко В.А., Василенко А.В. "Научно-методологические основы управления развитием курортных кластеров Крыма "				
Средняя оценка: 5,00		Экспертов: 1		
<b>Организация</b>	<b>Эксперт</b>	<b>Оценка</b>	<b>Комментарий</b>	
Российский университет кооперации, Чебоксарский кооперативный институт (филиал)	Серебрякова Татьяна Юрьевна	5 -	Претендует на статус победителя: интересный формат структурирования материала, исторические параллели с современностью, примеры, выводы автора свидетельствуют о качестве конкурсной работы.	

«Monographs» competition»				
1 2 3 4		Exit	Main menu	
Economy. Total entries: 74.				
1. «Volkova N.V.» INSTITUTIONAL ECONOMICS IN THE EXAMPLES				
Average mark: 5,00		Experts: 1		
Organization	Expert	Mark	Comment	
The All-Russian State University of Justice Teplaya Nina Vladimirovna		5	claims in the first place	
2. «Ryabchenko A.V.» ORGANIZATIONAL AND ECONOMIC MECHANISM OF INTEGRATED STRUCTURES OF THE ROCKET AND SPACE INDUSTRY FUNCTIONING				
Average mark: 5,00		Experts: 1		
Organization	Expert	Mark	Comment	
All -Russian Scientific Research Institute «Center» Moshin Andrej Yrievich		5	claims in the first place	
3. Vasilenko V.A., Vasilenko A.V. «Scientific-methodological basis for managing the development of resort clusters in Crimea»				
Average mark: 5,00		Experts: 1		
Organization	Expert	Mark	Comment	
Cheboksary cooperative Institute of the Russian University of Cooperation (branch)	Serebryakova Tat'jana Yrievna	5 claims in the first place	The paper can claim the winner status: an interesting format for structuring the material, historical parallels with the present time, examples, and the author's conclusions indicate the quality of the competition paper	

**Fig. 4.** Example of viewing publication ratings

The evaluation of student papers submitted to the competition was conducted from mid- July to mid -August 2019. The competition received 1,100 papers from 425 universities. The thirty two experts evaluated them. The competition jury reviewed the final rating lists of works. The winners in the “bachelor’s” and “master’s” categories were selected and awarded for each of the 12 research areas.

There were 315 books from scientific organizations and universities for the monograph competition. There was more competition time, taking into account the estimate complexity, compared to the student papers competition - it lasted from 1.05 to 15.11 2019. The forty specialists took part in the examination, and the winners were for each of the two categories (scientific and popular science publications).

## **5 Conclusion**

Conducted competitions show that the developed system is quite reliable, simple and easy to use, both from the editor viewpoint and from the expert viewpoint. There were no questions about working with the system during the contests that lasted for several months. The Expert system can be configured to hold online competitions of various topics and scales, ranging from intra-University competitions to national and international ones. It can be successfully used for the selection of literature to be included in the National electronic library of Russia [15].

The examination work of scientific materials takes significant time and intellectual expenses. In this regard, one of the serious issues that must have a solution when organizing an expert examination is expert motivation. The LNS RAS expert’s work the evaluation of the book market was motivated by the fact that (a) the experts received information on new publications and (b) when LNS RAS receives a book that was positively evaluated by an expert the LNS automated system sends him a special notification and he can immediately receive this book. During the competitions of scientific papers mentioned above, the incentive to participate in the expert examination was to provide the expert with free access for a year to all publications available in the «Direct-media» electronic library. Currently, this library contains «more than 70,000 scientific and educational publications, educational multimedia, interactive tests, 150,000 painting reproductions» [16].

Given the importance of forming a Common digital space of scientific knowledge and its reliable and most significant content, leading scientists of the country should be involved in expert selection of materials must be included in this space. They must have the appropriate motivation to do this work. Motivation should be not only and not so much material, but also an understanding of the necessity and social utility of this work. One of the possible solutions to this problem is to include work on the examination of scientific materials in the state task of leading scientific organizations in the country.

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