ICAS 2021 SHANGHAI
International Council of the Aeronautical Sciences
32nd Congress of the International Council of the Aeronautical Sciences
September 6-10, 2021 Pudong Shangri-La, Shanghai, China

CREATING A MULTI-FUNCTIONAL EXPERT ANALYTICAL SYSTEM IN THE AIRCRAFT INDUSTRY AND THE FORMATION OF GENERAL REQUIREMENTS

Budzko Vladimir I[1]., Kan Anna V[2]., Kazarinov German G.[2], Mikhalyn Ivan S.[2]

[1] FRC"COMPUTER SCIENCE AND CONTROL" of RAS
[2] NRC Zhukovsky

Abstract

The article shows the basic principles, methods and practice of creating an expert information system - a system of knowledge bases that provides an assessment of the effectiveness of advanced research in aerospace (EAS). EAS is expected to increase the scientific validity of decisions regarding formation and implementation of effective mechanisms and tools for managing science and technology development in the aviation industry of the Russian Federation.

For several years, the National Research Center "Zhukovsky Institute" has been carrying out a complex of works aimed at solving the problems of collecting and processing research results in aerospace activities.

The integrated expert analytical system (EAS) presented in this article provides the creation of a single digital information space by implementing unified technologies for automatic processing and formalization of the semantic content of reference, regulatory, technological and project documentation.

This development provides the interface of various information systems at the level of the exchange of documents processed according to uniform standards of semantic representation, obtained from various types of information sources.

The system allows for the analysis of multilingual scientific and technical documentation and the preparation of materials for use in the promotion of complex scientific and technical products.

The presented system will provide more effective support for decision-making in the management of research and development technologies in aerospace.[1.]

Keywords: : evaluation and review of R&D performance, projects in aircraft building

1. Introduction

At the present stage of development of the scientific and technological potential of the aviation industry, the need to make management decisions aimed at increasing the efficiency of research and development work in the development, manufacture and operation of aviation technology becomes especially relevant. Such decisions should be based on the use of objective analytical data on the development trends of world and domestic scientific and technological developments. This data can be obtained through meaningful comprehensive analysis of the global flow of scientific and technical information and analysis of the digital content of the industry.

Sources of such information can be foreign and domestic industry and departmental portals, websites of scientific institutions, editorial offices of journals, scientific conferences and communities, electronic media, as well as many other sources of scientific and technical information posted on the Internet. The source of the digital content of the industry can be scientific and technological, design and regulatory and technical documentation. In the process of automatic meaningful analysis of these multilingual heterogeneous distributed scientific and technical sources of information, promising foreign experimental and design developments in the industry can be identified, new knowledge is obtained, and priority scientific directions for the activities of research teams can be determined.

In high-tech industries, the tasks of automatic processing, analysis and management of digital content are of particular relevance when converting large volumes of scientific and technological, project and regulatory and technical documentation from paper form to their digital representation. Such tasks also cannot be solved without the use of modern semantic tools for automatic processing and formalization of digital industry content.

[1] Supported by the RFBR grant No. 18-29-03215 mk.

The lack of proven technologies and services for high-speed automatic processing, formalization and analysis of unstructured text information on the domestic IT market is a significant constraint for the implementation of these tasks. At the same time, the need to create industrial technologies to formalize the semantic content of heterogeneous multilingual scientific and technological texts is extremely urgent. These technologies should be based on modern ideas about the semantic structure of multilingual texts and on new high-performance methods and tools for analyzing unstructured text information.

Over the past several years, NRC Zhukovsky, work is underway to create a branch aviation multifunctional expert information system focused on solving these problems. The scientific approaches underlying this system were the logical development of research and technologies aimed at creating a new class of information and analytical systems based on modern high-speed methods of processing textual information, multi-agent semantic search in multilingual heterogeneous sources of information, meaningful analysis of scientific and technological digital content and extracting new knowledge from this content. These solutions comply with the requirements of the Program of Fundamental Scientific Research of the Russian Academy of Sciences for 2013-2020. (Informatics and information technology. Cognitive systems and technologies, neuroinformatics and bioinformatics, systems analysis, artificial intelligence, image recognition systems, decision making under many criteria), and are also in the field of digital technologies priorities laid down in the Program for the Development of the Digital Economy of Russia until 2035 g.

Further development of research and development work in this scientific area can be the development of principles, methods and technologies for creating an industry multifunctional integrated search and analytical system (EAS) in aircraft construction.

2. Goals and objectives of creating EAS

The purpose of the scientific solutions underlying the developed EAS is the development of models, methods, algorithms and technologies for creating an integrated automated information analysis and knowledge management system, the main task of which is to implement a single digital information space of the industry and provide holistic, reliable information and knowledge of all participants. life cycle of objects and processes in the field of development and operation management of complex engineering facilities of the industry.

Tasks to be solved:

• Development of refined models, methods, algorithms and technologies for automatic processing of texts, formalization of their semantic content and operational meaningful analysis of heterogeneous multilingual scientific and technological digital content of the industry.

• Development of a unified presentation of descriptions of the results of activities of participants in the implementation of management processes for complex engineering objects at different stages of their life cycle.

• Ensuring the completeness and availability of design, design, operational, scientific and other documentation related to various stages of the life cycle of complex engineering objects, including through automated export (or software integration) of data from automated specialized systems for various purposes, representing content in various formats and with different identification systems.

• Development of refined interfaces for interconnecting interconnected software and information components of automatic collection, processing, storage, analysis and semantic search.

• Ensuring stability in time, completeness and accuracy of information retrieval through the formation and dynamic updating of unified linguistic means of identifying the content of documents.

When implementing the system under development, it is planned to carry out a synthetic combination of three complex software and information components:

• documentary information retrieval systems and databases providing in-depth semantic search and analysis of heterogeneous information;

• linguistic support, built on the basis of hybrid methods of linguistic, semantic-statistical and conceptual analysis of texts, ensuring the construction of documents adequate to the semantic content of the texts of documents and requests of their formalized semantic images, over which operations are defined, including those corresponding to the processes of cognition;

• human-machine information interfaces providing a personalized representation of the user's cognitive trajectory.

This trinity is considered in the context of the general process of synthesis, presentation and search for knowledge, which predetermines the following tasks and areas of work:

- research of the processes of semantic search in the field of education, production and management on the basis of a systematic approach and cognitive models of this process;
- development of linguistic declarative means and methods for processing natural language documents and requests, allowing to build semantic search images, providing the ability to automatically analyze and draw conclusions on the material found on request documents (semantic indexing, mapping);
- development of a generalized object model of a document (as a communicative form of knowledge representation), which ensures effective presentation and processing of scientific content in processes related to various stages of the life cycle, as well as the formation of a document image that identifies the document itself and its semantic content at the level of basic entities and relations ;
- development of a model of information resources, which ensures the unification of the presentation of information and metainformation, as well as the construction of access services;
- development of models for the "construction" of options for representing the subject area (possible "picture of the world"), the evolution of which would be predictable;
- development of models and mechanisms for information retrieval based on dynamic query reformulation and adaptive classification of texts that implement controlled procedures for the formation of document combinations, each of which reflects a possible "picture of the world" and has its own backbone;
- development of a system of identifiers for the automatic establishment in the texts of scientific and technological documentation of objects of the life cycle of complex engineering systems and their parametric characteristics by methods of semantic-syntactic and conceptual analysis of these texts;
- research and analysis of the content of sectoral scientific and technological documents by linguistic and statistical methods in order to identify the main types of terminological syntactic structures and their lexical transformations, provided that their semantic content is preserved;
- development of a model of an adaptive visual interface that provides complex scenarios of search interaction, implementing not only the "request / response" function, but also analytical EAS is to provide a process automation evaluation of technological advance, the main directions forming conclusively prospective studies and evaluate the proposed work. For each of these processes are described its set of features, tools and methodological support. Based on the verbal model of the Center’s activity, the automation of the existing activity should ensure the fulfillment of the following general requirements, due to the composition and specificity of the processes implemented in the subject area, which include:

- informational and instrumental support to users and their interactions, as well as the procedures for the examination of the results of work performed;
- access to information relating to the used materials, technologies and components (parts, assemblies, units, avionics, etc.) effects and approaches, technical knowledge (artifacts);
- collections clustering composition directions of research and artifacts, and also possible to estimate performance of work, including analysis using methods publication activity and intensity information flows in the directions;
- automatic extraction of target information from scientific and technical documents / materials;
- tasks / clarification / cancellation of the connectivity of documents / materials related to one subject, to its selection / cluster, meaningfully homogeneous group;
- grouping (clustering) of documents / materials by user-defined custom filters, including the search for thematically close documents and materials;
- the possibility of constructing an abstract of the document / material containing thematically significant fragments of its text, as well as its search image;
- the possibility of semantic search of documents and materials in libraries using classifiers / rubricators;
- maintaining libraries of documents, both structured (technology passports, etc.) and non-structured, as well as descriptions of mathematical models.

3. Formation of general requirements for automation based on the main areas of research in the field of aircraft engineering

To analyze the data on the formation of the main directions of research in the field of aircraft engineering and to assess the effectiveness of the proposed work, the Center's Activity Plan was selected , which includes an interconnected list of long-term goals, priority scientific and technical directions and tasks for the development of science and technology in the aircraft industry, as well as

a list of medium-term scientific and technical, organizational and regulatory measures necessary to achieve the goals.

An important element of scientific and technical activity is the identification of new and monitoring of existing artifacts that are significant for the aircraft industry as a whole, planned for development, developed and used in the aircraft industry.

Based on the results of the collection, collections of documents are formed in these areas with the details of "prospects" and "state of affairs". To detail the "prospects", thematic clustering of collections (collections) on actively "discussed" topics is carried out, assessment of their prospects and formation of priority directions for the creation of scientific and technological directions of research in the aircraft industry.

The evaluation of the topics of work should be carried out by experts using EAS based on their comparison with the list of promising research areas and the existing scientific and technological reserve. When evaluating the work, scientific and technical, personnel, production, infrastructure and logistics potential, as well as communication opportunities in the territory of the Russian Federation and international relations should be taken into account. At the same time, the proposed works should not duplicate each other or previously performed works. To do this, it is mandatory to check for the presence of text borrowings in the text descriptions of the RID. In addition, it is mandatory to take into account the possible risks associated with the implementation of the proposed works.

3.1 Requirements for databases, knowledge bases and STD library

The requirements for databases, knowledge bases and STD library are justified both by the specifics of the subject area, and, in turn, are based on the requirements for the automated processes described above. Thus, it is necessary to distinguish the following requirements for databases, knowledge bases and the STD library:

Database:

- should contain both general data on the subject area "aviation technologies" and intermediate data for subsequent analysis and saving the results in the knowledge base;

- must store service information (for example, about EAS users) and information about authors, organizations, classification codes, etc. meta information about documents;

- should ensure high efficiency of the computing process in conditions of large amounts of data.

Knowledge base:

- should be a model of the subject area "aviation technologies" and represent a network of objects (persons, organizations, patents, technologies, etc.) connected by relations of various types with the possibility of output to networks;

- objects and sections of the knowledge base should be formed as a result of users ' work with the EAS based on intermediate information placed in the database;

- links in the knowledge base should be established automatically if they are explicitly indicated in the database, as well as on the basis of output to the network as a result of replenishment of the database.

Special attention should be paid to the requirements for the NTD and RNTD libraries within the subject area. Based on the above requirements and taking into account the specifics of the treatment of NTD and RNTD in this subject area, the following requirements for the libraries of NTD and RNTD can be distinguished. Library data:

- must be a full-text repository of documents together with their indexes;

- they must ensure the storage of documents on projects of the aviation transport system, data on scientific and technical groundwork in the aircraft industry, on promising aircraft construction technologies used in the world, as well as the storage of regulatory documents;

- must provide search and analysis of textual information, including the implementation of the following functions:

semantic search at the user's request with support for faceted search by metadata (both text and non-text) in the modes of semantic, conceptual search, as well as search by individual keywords;

exploratory search for documents (thematically similar to the specified reference document);

quick familiarization with the topic of documents using automatically generated keywords based on the text;

quick familiarization with the content of documents with the help of automatically generated summary texts;

formation, comparison and thematic analysis of user collections of documents (thematic clustering, construction of key thematic phrases, etc.);

search for semantic text borrowings;

thematic analysis of document collections;

- must support the following electronic document formats:*. txt,*. doc,*. docx,*. html,*. rtf,*. ps,*. pdf,*. odt;
- must be able to structure documents according to the following collections:

Russian scientific journals;

abstracts of dissertations;

Russian patents for utility models, inventions and industrial designs;

USPTO and WIPO foreign patents;

collection of internal documents of the Center.

3.2 Requirements for the architecture of an expert information system

The EAS architecture is the architecture of a distributed information system and includes the following main components –

- the central software core of the system;
- analytical core;
- knowledge base;
- database;
- STD library;
- Security Subsystem ;
- the subsystem of the user interface.

4. Technological problems solved by EAS

The consumers of the proposed technological solutions in the industry can be a wide range of subdivisions that have the task of collecting, processing, analyzing and managing scientific and technological digital content and performing a number of private scientific and technological tasks, such as:

• Information support of the life cycle processes of the projects being developed. Information support for the development of a complex scientific and technical product by searching and analyzing documentary information in local and external documentary resources, as well as organizing explicit and implicit knowledge related to the project.

• Analysis and examination of the content of scientific and technical documents (STD). Information support of an expert for automated analysis of the semantic content of scientific and technical documentation in the process of working with tender, contract, working, design, technological and reporting documentation.

• Working with multilingual normative and technical documentation and preparation for certification. Information support for the process of preparing documentation and conducting international certification of complex scientific and technical developments.

• Support of the design process at the level of requirements control. Information support of the process of developing a complex scientific and technical product according to the requirements and conducting a formal inspection of the requirements.

• Support for the promotion, operation and maintenance of complex scientific and technical products. Information support for the promotion of complex scientific and technical products, preparation of operational and marketing documentation, as well as presentation and reference materials for international markets.

In terms of information support for the life cycle processes of complex engineering objects, the following is performed:

• factual search;
• thematic search;
• problem-oriented search;
• search for analogs;

• search for dependencies (dynamics);
• complex search (multi-object, multi-stage) for project monitoring tasks (achievement of technical requirements, consistency (consistency) of parameters, properties); analysis of borrowings; identification of grounds, limitations; identification of potentially possible semantic relationships.
In terms of the analysis and examination of the content of STD, the following is carried out:
• assessment of the compliance of the documentation with the established criteria and requirements (terms of reference, requirements of standards, etc.);
• correlation of proposals / results with the modern level of science and technology and the assigned strategic directions of development;
• search for similar and related projects (identification of borrowings, analysis of novelty in relation to previous projects and stages, identification of duplication of work in related projects);
• creation of information models of the mentioned objects for a given set of documents.
In terms of work with multilingual regulatory and technical documentation and preparation for certification is carried out:
• providing a standardized translation of the terminological apparatus of the subject area;
• ensuring the ability to work with foreign regulatory and technical documentation in the user's language;
• correlation of the requirements of national standards and internal technical regulations with the requirements of international standards;
• correlation of the provisions of the project documentation with the requirements of the standards;
• maximum use of the results of certification of individual elements and previous models, previously internationally certified;
• preparation of output documentation in a foreign language (taking into account the versioning of the development and comments of the participants in the certification process);
• ensuring traceability of documentation in the process of validation of individual provisions of the requirements.
In terms of supporting the design process at the level of requirements control, it is carried out:
• automated creation and maintenance of an information model of the product life cycle in terms of the terminology of individual components at different stages of the life cycle;
• ensuring end-to-end control of mutual compliance of requirements for properties and parameters at all stages of the life cycle (from standards, technical specifications, development plans, requirements specifications to working documentation and formal inspection reports);
• control of the use of standardized terminology in the preparation of documentation;
• correlation of semantic fragments related to information descriptions of objects throughout the entire set of project documents;
• development of requirements using formal logical templates and automated replacement and substitution of component parts of requirements from accompanying documentation;
• use of an ontological resource in the process of developing and analyzing requirements;
• automated verification and formal inspections of the requirements of project documentation for specified questionnaires using semantic search technology.
In terms of supporting the operation processes and maintenance of complex scientific and technical products, the following is carried out:
• preparation of exploitation.

5. The role of EAS in assessing prospects for the development of aircraft engineering and evaluating R & D

It is planned to use EAS for information support of decision-making, including support for the activities of experts and analysts, for example, during the examination of topics or R & D results within the framework of the implementation of the State Program of the Russian Federation "Development of the Aviation Industry for 2013-2025" [7].
Thus, the EAS should provide for the following use cases, but not be limited to them:
Assessment of the level of readiness of the created technologies (technology readiness level) using the functions of full-text search of EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents;
Conducting an assessment of the level of production readiness (manufacturing readiness level) using the full-text search function of the EAS, building aggregated statistics on collections of full-text scientific

and technical documents and logical inference from the knowledge base;
Identification of technology use cases using methods of extracting information from the full texts of scientific and technical documents (primarily patents, as documents containing descriptions of technology application options) that will be implemented in the EAS, building key vocabulary and summaries of full-text scientific and technical documents;
Conducting an assessment of compliance with research areas and topics of ROC conducted abroad, using the functions of full-text search of EAS and building aggregated statistics on collections of full-text scientific and technical documents, including the databases of the US Patent and Trademark Office (USPTO) and the World Intellectual Property Organization;
Conducting an assessment of the availability of reserves, patents and scientific publications that are thematically close to the topic of R & D for a team of R & D or R & D performers using the search function for similar EAS documents;
Determination of compliance of the research and development or R & D topics with promising areas using the search function for thematically similar EAS documents;
Determination of the correspondence of the results presented in the report to the declared R & D topic using methods for assessing the thematic similarity of full-text EAS documents;
Identification of similar or duplicate R & D using the search function for fuzzy duplicates and text borrowings in the R & D and R & D databases implemented in the EAS;
Search for similar scientific and technical solutions using the search function for thematically similar documents in the databases of scientific and technical solutions;
To rank the competence centers of aviation science according to the technical task for research and development or ROC;
Evaluation of the dynamics of the publication activity of the scientific community within a given topic of a thematic area using the functions of full-text search of EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents, including the construction of a diagram of the distribution of scientific publications and dissertations by year;
Assessment of the level of development of the direction by patent holders using the functions of full-text search of EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents, including the construction of a diagram of the distribution of patents by copyright holders;
Assessment of the relevance of the results of R & D or R & D using the full-text search functions of the EAS for collections of patents and patent applications in order to identify the ratio of patent applications to existing patents that are substantially and thematically similar to the results obtained;
Assessment of the ratio of the number of industrial designs and computer programs and the number of inventions and utility models using the full-text search functions of the EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents, including the construction of a diagram of the distribution of patents by their types;
Identification of interest in the direction on the part of patent holders in Russia and abroad using the functions of full-text search of EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents, including the construction of a diagram of the cumulative patent mass in the analyzed direction, while estimating the increase in the cumulative patent mass in the analyzed direction of aircraft development;
Identification of interest in the direction from the media using the full-text search functions of the EAS and the construction of aggregated statistics on collections of full-text publications of specialized media, including the construction of a diagram of the distribution of media publications by year ;
Assessment of the expected level of competition in the Russian Federation from foreign companies using the functions of full-text search of EAS and the construction of aggregated statistics on collections of full-text scientific and technical documents, including the construction of a diagram of the distribution of patents by copyright holders and a diagram of the state affiliation of patent holders with the calculation of the share of foreign industrial companies among patent holders;
Evaluation of scientometric indicators of the team's performers using full-text search functions and data from scientometric databases;
Identification of the terminology used in scientific and technical documents to designate the key elements of the technologies being created using methods of extracting information from full texts, constructing the key vocabulary of scientific and technical documents and their collections, constructing

summaries of full-text documents;
Identification of technologies created within the framework of the direction using methods of extracting information from the full texts of patents (as scientific and technical documents containing a description of technologies and their application) and logical inference from the EAS knowledge base.
Identification of options for the use of technologies created within the framework of the direction in the aircraft industry using methods of extracting information from the full texts of patents (as scientific and technical documents containing a description of technologies and their application), building a key vocabulary of patents and their collections, building a summary.
Depending on the specific tasks related to the assessment of the prospects for the development of the aircraft industry or the assessment of research and development, experts and analysts can apply various subsets of the above (or other) options for using EAS.

Conclusion

Currently, the NRC Zhukovsky carried out a set of studies aimed at solving particular problems of collecting, processing, searching and analyzing the digital content of the industry, as well as created a scientific and technological potential for solving these problems on an industrial scale ... Such tasks can be comprehensively solved by creating an integrated search and analytical industry system (IPAS). The proposed IPAS will ensure the creation of a unified digital information space for the industry through the implementation of unified technologies for automatic processing and formalization of the semantic content of regulatory, reference, scientific, technological and project documentation. These technologies can also ensure the interconnection of various third-party information systems at the level of exchange of documents processed according to uniform standards for the semantic representation of documents obtained from various types of information sources.

The main competitive advantage of the proposed concept EAS is the fact that the development of this system will be based on modern theoretical concepts of the semantic structure of multilingual text information, which ensures the implementation of promising technologies for automatic processing of reference, scientific, technological and design documentation, semantic search in the industry array of these documents, meaningful analysis and mechanisms for extracting knowledge from the digital content of the industry.

References

[1] . Upravlenie nauchno-tekhnologicheskim razvitiem vysokotekhnologichnoj promyshlennosti: problemy i resheniya [Management of scientific and technological development of high-tech industry. problems and solutions]. Ed. Dutov A.V., Klochkov V.V. M. NIC «Institut imeni N.E. ZHukovskogo», 2019, 248 p. (In Russian).

[2] . Dutov A.V., Kan A.V., Klochkov V.V., Shakun A.V., Shapkin V.S. Main directions of research activity in the interests of development of the air transport system of the Russian Federation. Nauchnyj vestnik GosNII GA=Scientific Bulletin of the State Scientific Research Institute of Civil Aviation. 2019, no.29, pp. 9-21. (In Russian).

[3] Dzhamaj E.V., Demin S.S., Sazonov A.A. Digital technologies in aircraft industry and features of transformation of business tasks within the genesis of the new technological concept. Nauchnyj vestnik GosNII GA=Scientific Bulletin of the State Scientific Research Institute of Civil Aviation 2019, no. 29, pp. 86-98. (In Russian).

[4] Zakharov V.N., Khoroshilov A.A., Khoroshilov A.A. A method for automatically detecting implicit borrowings in scientific and technical texts. Iskusstvennyj intellekt i prinyatie reshenij=Artificial Intelligence and decision-making. 2017, no.1, pp. 10-20. (In Russian).

[5] Zakharov V.N., Khoroshilov A.A., Khoroshilov A.A. Razrabotka metoda transformacii poiskovogo zaprosa v ego unificirovannoe semanticheskoe predstavlenie dlya zadach informacionnogo poiska v mnogoyazychnyh massivah dokumentov. Sed'maya Mezhdunarodnaya konferenciya «Sistemnyj analiz i informacionnye tekhnologii» SAIT – 2017 [Development of a method for transforming a search query into its unified semantic representation for information search tasks in multilingual arrays of documents. Seventh International Conference «Systems Analysis and Information Technology»]. (13 – 18 iyunya 2017. Svetlogorsk, Rossiya): Trudy konferencii. FIC IU RAN, 2017, pp. 230-235. (In Russian).

[6] Budzko V.I., Kalinin Yu.P., Kozerenko E.B., Khoroshilov A.A.,Khoroshilov A.A. Machine grammar of the Russian language. Sistemy vysokoj dostupnosti=Systems of high availability. 2017, vol.13, no.3, pp.19-33. (In Russian).

[7] Kalinin Yu.P., Khoroshilov A.A., Khoroshilov A.A. Principy sozdaniya sistemy monitoringa i analiza mirovogo potoka nauchno-tekhnicheskoj informacii. [The principles of a monitoring system and analysis of the global flow of scientific and technical information]. Sistemy i sredstva informftiki=Systems and means of informatics, 2016, vol. 26, issue 1, pp. 139–165. (In Russian).

[8] Dmitrishin A.N., Kalinin Yu.P., Khoroshilov A.A., Khoroshilov A.A. Method of searching textual information in multilingual arrays (for example, Russian-English text collection). Informatizatsiya i svyaz'=Informatization and communication. 2016, no. 4, pp. 53-58. (In Russian).

[9] Victor Zakharov, Alexcandr Khoroshilov, Alexey Khoroshilov A Method of Automatic Plagiarism Detection in Multilingual Documents. Selected Papers of the XVIII International Conference on Data Analytics and Management in Data Intensive Domains (DAMDID/RCDL 2016). CEUR Workshop Proceedings Vol-1752. P. 181-186. (In English).

[10]Zakharov Victor N., Khoroshilov Alexey A., Khoroshilov Alexander A. On The Method for Automatic Determination of Semantic Similarity if the Document Text // Proceedings of ICAI'14, WORLDCOMP'14, July 21-24, 2014, Las Vegas, Nevada, USA-CRSEA Press, USA, 2014, Vol.II. P. 68-73. (In English).

[11]Kalinin Yuri P., Kozerenko Elena B., Khoroshilov Alexander A., Khoroshilov Alexei A. New Translation Directions Development Technolgies in the MetaPhrase Machine Translation System/ Proceedings of the 2015 International Conference on Artificial Intelligence (ICAI 2015) WORLDCOMP'15, July 27-30, 2015, Las Vegas Nevada, USA v.I. USA, Las Vegas Nevada, 2015, Vol. №1. ISBN:1-60132-217-8, 1-60132-218-6 (1-60132-219-4). (In English).

6. Copyright Statement