Date of publication JUN-28, 2021, date of current version MAY-14, 2021.
www.computingonline.net / computing@computingonline.net

Print ISSN 1727-6209
Online ISSN 2312-5381
DOI 10.47839/ijc.20.2.2170

Model of Explicit Knowledge Management in Organizational and Technical Systems

OLEKSANDR ANDROSHCHUK[1], RUSLAN BEREZENSKYI[2], OLHA LEMESHKO[3], ANDRIY MELNYK[4], OKSANA HUHUL[4]

[1]Khmelnytskyi National University, 46 Instytutska street, Khmelnytskyi, 29007, Ukraine (e-mail: asa_20_1968@ukr.net)
[2]Military Academy, 10 Fontanska doroha street, Odesa, 65009, Ukraine (e-mail: ruslan3438@gmail.com)
[3]Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, 46 Shevchenko street, Khmelnytskyi, 29007, Ukraine (e-mail: lemeshkolia@ukr.net)
[4]West Ukrainian National University, 11 Lvivska street, Ternopil, 46009, Ukraine (e-mail: melnyk.andriy@gmail.com, OksanaGGG@i.ua)

Corresponding author: Oleksandr Androshchuk (e-mail: asa_20_1968@ukr.net).

ABSTRACT The technical component of knowledge management in organizational and technical systems in various fields, as well as in military formations and law enforcement agencies has not been investigated. In order to find the key characteristics of a comprehensive knowledge management model in organizational and technical systems, the main actions with knowledge and directions of implementation, realizing the recently developed knowledge management models, have been examined. There is provided to add a technical component to the model of explicit knowledge management in organizational and technical systems, implemented by the information and telecommunication system, the server of which is located, for example, in the research institution, the modeller or the educational institution. All components of the model of explicit knowledge management in organizational and technical systems accomplish acquiring of explicit knowledge from the knowledge management system in the organizational and technical systems or, if necessary, providing of explicit and implicit knowledge to the knowledge management system in organizational and technical systems. Implementation of the proposed explicit knowledge management model in organizational and technical systems is suggested to be implemented using the ontological approach of knowledge formalization and consideration. Thus, a combination of syntactic and semantic search is used, that is, the search is performed in instances of ontology, taking into account their semantic characteristic and connections.

KEYWORDS management; explicit knowledge; model; organizational and technical systems; information and telecommunication systems.

I. INTRODUCTION

MANAGEMENT tasks of organizational and technical systems (OTS) are poor or non-formalized and occur under the conditions of uncertainty. The experience of the most successful OTSs shows the crucial role of the systems of gathering, development and management of knowledge in the process of successful implementation of OTS goals and it is the key of success in their activities.

There are a lot of scientific works dedicated to the problem of knowledge management [1-3], such as those of Milner B., Nonak I., Yampolskyi V., etc. These authors, first of all, paid considerable attention to the issue of knowledge management system development. Secondly, the analysis shows that the regulations development of the knowledge management theory is at initial stage. Thirdly, almost all works concern commercial and industrial OTSs. Attention to the state (military and law enforcement) OTSs, which have the appropriate features, etc., has not been paid at all.

Thus, the issue of knowledge management system model development in OTS management is considered to be insufficiently investigated. Also, the peculiarities of knowledge management during the reorganization are not enough studied.

It's extremely effective to use knowledge management in various subject areas (education, military sciences, transport, etc.) in order to train specialists on border security, personnel management and foreign communication.

The availability of unresolved problems and the urgent need for their solution determine the importance of this article. There are explicit and implicit types of knowledge in the knowledge management. The explicit and implicit components are compulsory and interdependent at knowledge management system. Many specialists need to manage their knowledge, as implicit as explicit and also OTS knowledge.

The process of knowledge management consists of the following components: technical (the development of intelligent information systems for the explicit knowledge management) and the human (Human Recourse management for the implicit knowledge management). In this case, the implicit knowledge, uploading into the automated information system, becomes explicit. Issues of knowledge management in OTS were investigated mainly regarding to the human component. At the same time, the technical component of knowledge management in OTS in various fields, as well as in military formations and law-enforcement agencies has not been practically studied.

In order to find the key features of the comprehensive model of knowledge management in OTS, we study the main actions with knowledge and directions of implementation realizing the worked out knowledge management model:

Kogut & Zander [4] – knowledge management system (KMS) development, its transformation, usage process, opportunities and competitive advantage of OTS on KMS use;

Wiig [5] – development, search, assembling, transformation, distribution and use of implicit knowledge;

Gunnar Hedlund (N-Form) [6] – connection and internalization, expansion and appropriation, assimilation and distribution of implicit knowledge;

Nonaka & Takeuchi [7] – exchange of implicit knowledge, KMS concept development, its assessment, structure development, structure aligning;

Nickols [8] – acquisition, organization, specialization, keeping/access, obtaining, distributing, removing of implicit knowledge;

Meyer & Zack [9] – collection, cleaning, keeping / access, distribution, presentation;

Skyrme [10] – search, implicit knowledge use, development, acquisition/ codification of database;

Boisot [11] – codification, abstraction, diffusion of implicit knowledge;

Michael Earl [12] – inventorying of individual and organizational knowledge, audit, socialization, implicit knowledge expertise;

Crossan [13] – intuition, interpretation, integration, institutionalization of implicit knowledge;

David Snowden [14] – exchange of implicit knowledge, exchange of explicit knowledge, transformation of implicit knowledge into explicit knowledge, explicit knowledge use;

Soliman & Spooner [15] – creation, "capture", organization, implicit knowledge use, organization of access to knowledge;

Bukowitz & Williams [1] – receiving, using, studying, assessment, development/maintaining, knowledge cleaning;

Alavi & Leidner [16] – development, keeping/search, transfer, knowledge application;

Rollet [17] – planning, development, integration, organization, transfer, keeping, knowledge assessment;

Sağsan [18] – development, exchange, structuring, use, implicit knowledge audit;

Us G. [19] – offered KMS model of enterprise based on agents.

Becerra-Fernandez&Sabherwal [20] – development, "capture", joint use of implicit knowledge;

Serrat [21] – management methods, cooperation mechanisms, knowledge and education exchange and also collection and keeping of implicit knowledge are investigated.

With the aim of adapting the above mentioned models into the development of a model of explicit knowledge management in OTS, it is reasonable to transform them, taking into account the above-formulated peculiarities of functioning, namely creation of the mechanism for the knowledge acquiring by all interested individuals in the management of OTS, computerization and the subject area.

II. MATERIAL AND METHODS

The article was written based on the materials of dissertation research. Also, the authors took part in a number of research and development activities.

The following methods were used in the research: system analysis, ontological consideration – to develop the model of explicit knowledge management in OTS; methods of experiment and statistics theory – for the processing of experimental data and their interpretation.

III. RESULTS

We propose to add a technical component to the model of explicit knowledge management of OTS, implemented by the information and telecommunication system, the server of which is located, for example, in the research institution, the modeller or the educational institution. In turn, Human Machine Interfaces (HMIs) are located in all components of the explicit knowledge management model of OTS. Components of the model are circumstantiated in Fig. 1.

Information technology tools include means that support IT-infrastructure, information and technical, and program and analytical support for the implementation of processes of KMS in OTS. These are intelligent databases, a portal, distance learning systems, blogs, virtual offices, database analysis tools, expert systems, accessed through the HMI of each component of the model of explicit knowledge management of OTS.

The following components are proposed to be added into the model of explicit knowledge management of OTS:

Cabinet of Ministers – defines the national policy in a specific subject area, for example, the activities of military formations and law enforcement agencies: the execution of the law, regulating the work of OTS (other guidelines), the introduction of scientific and technological progress, provides and obtains knowledge, etc.;

Ministry office (department), to which OTS belongs – implements the strategy of OTS development, carries out the general management of OTS, provides and receives knowledge. Ministry Department which is responsible for OTS – is the adviser of OTS development, develops the KMS project on the basis of proposals from modellers and users, provides and receives knowledge, if it is necessary fills this system with the necessary knowledge from the KMS in the projects;

Department on OTS management – an additional body, which is proposed to be introduced by the authors, performs management of OTS;

Department on Knowledge Management – performs general knowledge management in OTS, including management of explicit knowledge, provides the creation and maintenance of KMS in OTS;

Research and Development enterprise (Institute of the Mathematical Machines and Systems Problems, Institute of Software Systems, etc.) – provides scientific maintenance of the KMS and develops all kinds of automated information system (AIS) provision, implements the filling of the KMS in OTS;

other domestic and foreign institutions – provide free or on a commercial basis AIS;

Higher educational establishments (on OTS subject area) – provide training of personnel and scientific support of OTS, as well as the filling of the KMS in OTS;

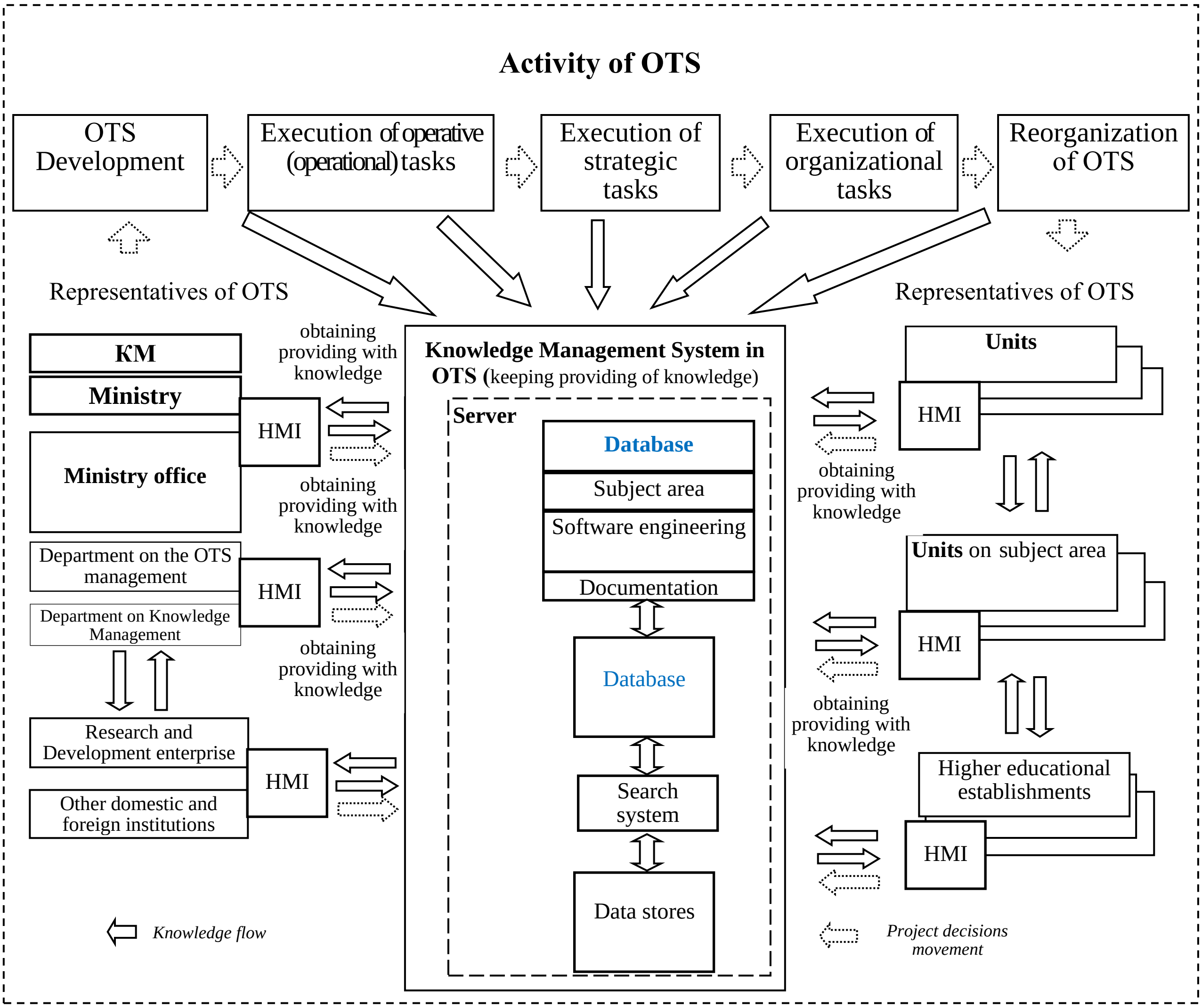


Figure 1. Model of explicit knowledge management in organizational and technical systems

OTS units use developed KMS based on AIS, participate in the development of technical tasks, and correct the KMS components during their implementation. Consequently, all components of the model of explicit knowledge management in OTS, provide obtaining of explicit knowledge from the KMS in OTS, or, if necessary, provide explicit and implicit knowledge to KMS in OTS. KMS obtains, processes, keeps and draws knowledge. That is, the model of explicit knowledge management involves: obtaining and formalizing of implicit knowledge, obtaining of explicit knowledge, keeping and the spread of explicit knowledge, which are depicted in Figure 1 as “knowledge flow”.

The concept of the developed KMS in OTS is a combination of two types of KMS (with application of components of information and search systems and artificial intelligence systems). The key component of the KMS in OTS is the search subsystem, which provides the prompt selection and the output of relevant information from queries. The search for information is made not in the document repository, but in knowledge databases (ontological), which allows noting the semantics documentary information describing the activities of OTS, interconnections and interdependence, ensuring the integrity and consistency of knowledge, improving the quality of the search.

In order to determine the structure of the interconnections between the elements of knowledge in OTS, it is necessary to isolate (abstract) the concept from the content of the knowledge elements (documents, employees experience, etc.) and to structure (organize) them in a formal way, by tasking the interconnections between these concepts. At present day, the task of forming conceptual “transparent” submissions for weakly structured subject areas is perspective. Currently, according to the most common paradigm, information flows are best structured using an ontology or hierarchical conceptual structure, which is formed by the personnel responsible for knowledge on the basis of research and formalization of information flows, data, arrays of singled out knowledge, etc. [14, 21].

The implementation of the proposed model of explicit knowledge management in OTS is offered to be realized using the ontological approach to knowledge formalization and output. So, a combination of syntactic and semantic search is used, that is, the search is performed in exemplars of ontology, taking into account their semantic qualities and interconnections. The ontological component of the model is shown in Fig. 2.

For the first time, the notion of ontology in the field of IT was used by T. Gruber. This is a specification of conceptualization, where conceptualization is a characterisation of concepts, as well as all information concerning concepts and is necessary for the description and solution of the subject area tasks. Ontologies are used to represent well-known knowledge, as well as the acquisition, structuring of knowledge and the formation of new knowledge in the subject area [22]. In other words, ontology is an attempt of “comprehensive and detailed formalization of a certain field of knowledge through a conceptual scheme. Such a scheme, as a rule, consists of a hierarchical data structure that contains all relevant kinds of objects, their interconnections, theorems and constraints that are adopted in a particular subject area” [24]. Consequently, the ontology of the management of OTS is formalization (specification of conceptualization) of the knowledge field in relation to the subject area management of OTS.

Ontologies are data models that have two specific features leading to the concept of common understanding or semantics: ontologies are developed on the basis of a common understanding of the subject area by the personnel; ontologies give an opportunity to carry out knowledge output.

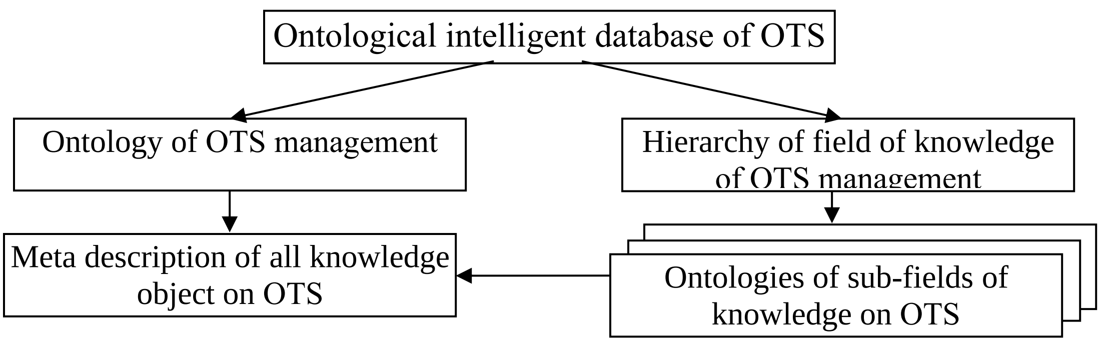


Figure 2. Structure of ontological component of the model of knowledge management system in OTS

Ontologies use the method of knowledge submission that can be processed by the AIS (that is, they are developed using high-level languages such as RDFS or OWL [14, 21]). Computers work with ontologies on this base.

These capabilities include: data transfer (ontologies) between computer systems; preservation of ontologies; control of coordination of ontologies; accomplishment a logical output on ontologies and using ontologies (computer-based knowledge management on ontologies). The use of ontology to describe the explicit knowledge management model allows taking advantage of discrete logic device to perform logical output operations on concepts and metadata of ontology. The use of ontology allows interpreting concepts (and their corresponding terms) by specialists of the organization, as well as by computer programs for KMS in projects. Consequently, the ontology of OTS management is one of the most attractive approaches to managing explicit knowledge in this field.

In general form the formal ontology of OTS management can be described by the following tuple [26]:

$$O = \{L, C, F, G, H, R, A\}, \quad (1)$$

where "$L = L^C \cup L^R$ – is a dictionary of ontology, containing a set of lexical units (marks) for the concepts of L^C and a set of signs for relations to L^R; C – a set of notions of ontology, and also there is at least one statement in ontology for every concept $c \in C$; F and G – functions of links are such as F: $F^{LC} \to 2^C$ and G: $F^{LR} \to 2^R$. That is F and G link sets of lexical units $\{L_j\} \subset L$ with sets of concepts and relations to which they respectively refer in this ontology. In this case, one lexical unit can refer to several concepts or relationships, and one concept or relation can refer to several lexical units. Inverse of link functions are F^{-1} and G^{-1}; H – fixes the taxonomic character of relations (connections), in which the concept of ontology is related to non-reflexive, acyclic, transitive relations $H \subset C$ x C. The expression for H (C_1, C_2) means that the concept C_1 is a subordinate of C_2; R – denotes the binary character of the relationship between the concept of ontology that fix pairs: the field of usage (domain) / field of values (range), that is, the pair (DR) of $D, R \in C$; A – a set of axioms of ontology".

In the simplified view the formal submodule of the ontology of OTS management is defined as the ordered triple set [26]:

$$O = \langle C, R, A \rangle, \quad (2)$$

where C – is a set of concepts of the subject area (for example, motor transport facilities), which is described by ontology O; R – is the set of relations between concepts; A – a set of axioms (laws and rules that describe the principles of the concepts existence). Such a model is heavy-load or "significant". Therefore, it is proposed to simplify it further. The easy model or "light" ontology is defined as [26]:

$$O = \langle C, R \rangle. \quad (3)$$

About 80% of developed ontologies belong to the "light" [26].

Ontology of OTS management contains three components that complement one another and form a complex of ontological models of explicit knowledge management in OTS [26]:

$$O = \langle O_P, O_{SE}, O_{SA} \rangle, \quad (4)$$

where O_P – is ontology of OTS; O_{SE} – ontology of software engineering; O_{SA} – is ontology of the subject area.

The concepts that belong to the theory of OTS management are singled out in the ontology of OTS. The following model of ontology of OTS is proposed:

$$O_P = \langle AD, FD, LD \rangle, \quad (5)$$

where O_P – is ontology of OTS; AD – a finite set of attributes describing the properties of the concepts of the OD and the relations RD between them; FD – is a set of restrictions on attribute values; LD – separate components of the theory that are related to the concept.

There is a subset of key attributes for each concept (class), which serve for unambiguous identification of instances. The ontology of OTS management can contain more than 100 concepts.

Ontology of software engineering AIS O_{SE} is considered as a pair: signature (term – functional capabilities) from the programming hierarchy S and the set of W of keywords, synonyms and abbreviations to the signature:

$$O_{SE} = \langle S, W \rangle. \quad (6)$$

The hierarchy in the ontology of software engineering of O_{SE} is based on the relationship of type "class-subclass". A direct relationship is established between the ontology management of project IT development and software engineering with the help of the conceptual relation "manage of functionality" – the relation between parts of the AIS and the functional capabilities.

The ontology of the subject area includes the concepts that belong to the results of OTS (for example, subsystem, product, product group, etc.). The following model of ontology of the subject area is proposed:

$$O_{SA} = \langle A_P, F_P \rangle, \quad (7)$$

where O_{SA} – is ontology of the subject area; A_P – a finite set of attributes describing the qualities of O_P concepts and R_P relationships between them; F_P – is a set of restrictions on attribute values.

The task on creating of instances of product ontology and forming relations between them is carried out by product group managers. The name of the product instance and its place in the hierarchy is determined at the stage of sketchy or technical designing, and is fixed in the design documentation.

Meta-descriptions are created for objects containing knowledge, which are described in the ontology management of OTS (documents, specialists, projects, products, etc.) that are used in the work of the KMS in OTS. Meta-descriptions (description of characterizing) – this is especially structured information that characterizes the content of documents, information resources and knowledge bases, profiles of experts competence, etc., which may be useful to both users and the KMS itself. Meta-descriptions represent various qualities and characteristics of an object, such as status, format, semantics, etc.

Under the metadata of the object O_i will be understood the following statement [3]:

$$MD = C_i \cup I_i, \quad (8)$$

where C_i is the set of concepts of ontology *O* that relate to object *i* and are located in information about object (documents, databases and knowledge, etc.) and in the user's interest. Each concept is connected with own weight coefficient K_i; I_i – is a set of copies of the *O* ontology concepts with copies of relations between them.

On that basis, as well as from the formal model of ontology, for the totality of objects of OTS subject area, it is possible to determine the structure of metadata (meta-descriptions) [26]:

$$MD = \{O, I, L, inst.c, inst.r, inst.l\}, \quad (9)$$

consisting of: an ontology containing *C* and *R*; set *I*, elements of which are identified instances; set of values of literals *L*; functions *inst.c*: $C \rightarrow 2^I$, referred to specification of concepts (conceptions); the functions *inst.r*: $R \rightarrow 2^{Ixi}$, referred to the specification of relations (conceptions); the functions *inst.l*: $R \rightarrow 2^{Ix\,L}$, called the specification of the attributes of the concepts, which connects the instances of the ontology with the values of literals.

The specification of the concept is in determining the correspondence between the concept and the specimen. The result of concretization may be not completely certain concept, that is, the very concept without the values of attributes. The degree of connection of concept with the description of the object will be used in the indefinite notion as a literal {0, 1}.

Formalized presentation of ontologies, as well as meta-descriptions of objects, creates an opportunity to measure the proximity (similarity) of objects in the intellectual space. The similarity between the metadata of $Sim(MD_i, MD_j)$ can be defined through the similarity of the included instances:

$$Sim(MD_i,MD_j) = \sum I_{i \in MD_i} \sum I_{j \in MD_j} sim(I_i, I_j), \quad (10)$$

where $Sim(MD_i, MD_j)$ – is the value of similarity of meta description of the object *i* and the object *j*; $sim(I_i,I_j)$ – is the magnitude of the proximity of the instances of the concepts I_i i I_j, which are included in the comparable meta-description.

It is possible to distinguish the following measurement components of the similarity of two instances of concepts:

1) Taxonomic (in proximity to the ontology hierarchy, $TS(I_i,I_j)$);

2) Relational (by the similarity of relations of instances, $RS(I_i,I_j)$);

3) Attributive (by the proximity of the attribute values, $AS(I_i,I_j)$).

The total magnitude of the $sim(I_i,I_j)$ of the instances I_i and I_j is determined by the formula

$$sim(I_i, I_j) = \frac{t \times TS(I_i, I_j) + r \times RS(I_i, I_j) + a \times AS(I_i, I_j)}{t + r + a}, \quad (11)$$

where *t, r, a* – are the influences of different measurements of similarity that can be selected depending on the importance taking into account different measurements of similarity (for example, in [26] influence equal to 2 for relational similarity was used, since the most important part of information ontology and related metadata kept in the relations).

There are different ways in evaluation of the likeness. Let us study one of the proposed variants of their calculation [26].

The taxonomic similarity between instances *Ii* and I_j, that $C_i(I_i)$ and $C_j(I_j)$, is calculated taking into account the position of the corresponding concepts of C_i and C_j in taxonomy H^C. To calculate the semantic distance in the hierarchy of concepts, we will use the set *UC* (upwards cotopy), which contains all the concepts that are above of the H^C hierarchy, and the very investigated concept:

$$UC(C_i,H^C) = \{C_j \in C \mid H^C (C_i,C_j) \vee C_j = C_i\}.$$

The semantic characteristics of H^C are used: the consideration is limited to the super-notions of the given concept C_i and the reflexive relationship between C_i and itself. Based on the definition of *UC*, it is possible to determine the taxonomic likeness in such a way:

$$TS(I_i, I_j) = \frac{UC(C_i, H^C) \cap UC(C_j, H^C)}{UC(C_i, H^C) \cup UC(C_j, H^C)}. \quad (12)$$

All modern ontologies (regardless of the language specification and its program implementation) are developed approximately in the same way. The main components of ontologies are [3]: concepts (sometimes are called classes, notions, entities, categories); characteristics of concepts (sometimes are called slots, attributes, roles); relations; restrictions (sometimes are called facets, limitation of roles).

Concept is a template that contains a set of rules that determine the form of an instance, that is, how an instance can be constructed. An instance of the concept serves to represent the element of the subject area.

Concepts can have characteristics (attributes) – the names or structures of the record fields and characterize the size or type of information contained in the field. Concepts are used to keep information about an instance of a concept. The attribute value can be both complex and simple.

Relationships are dependences between concepts (instances) of ontologies. Usually, the relationship is an attribute that refers to another instance.

Concept properties may have different limits that describe the type of the value, the allowed values, the number of values (power), etc.

Consequently, the future structure of the KMS in OTS will be based on the developed model of explicit knowledge management in OTS. The model of knowledge makes the conceptual basis of the KMS in OTS – defines a set of terms (concepts) and relations, as well as algorithms (rules) for their common use. Knowledge base of KMS in OTS (instances of concepts) is formed from meta-descriptions of all objects that can contain knowledge.

The knowledge search mechanism processes metadata of objects and selects those that are relevant to the user's inquiries. The functional subsystems of KMS in OTS allow subsystems to search knowledge to be used by users to receive various services (for example, it may be navigating through different elements of knowledge bases and document repositories).

The functioning of different subsystems of the KMS in OTS (in relation to the search, formalization of knowledge) is associated with the definition of the semantic closeness of the object pairs, or rather their meta-descriptions. Descriptive logic is used to perform logical output. Descriptive logic describes knowledge in terms of concepts and limitations of roles that are used to automatically deduce classification of taxonomies. These logics have a strong influence on modern ontology languages [3].

Determining the degree of similarity between documents is to find the similarity between sets of weighted terms of ontologies. Methods of calculating the similarity/distances between semantic metadata are used, which are given in [3]. The use of ontologies concepts and assessments of semantic propinquity allows creating a single intellectual space in which all knowledge management objects of OTS [3] are located.

The main technologies that will implement the proposed model are:

1) Decision-making support (Decision support);

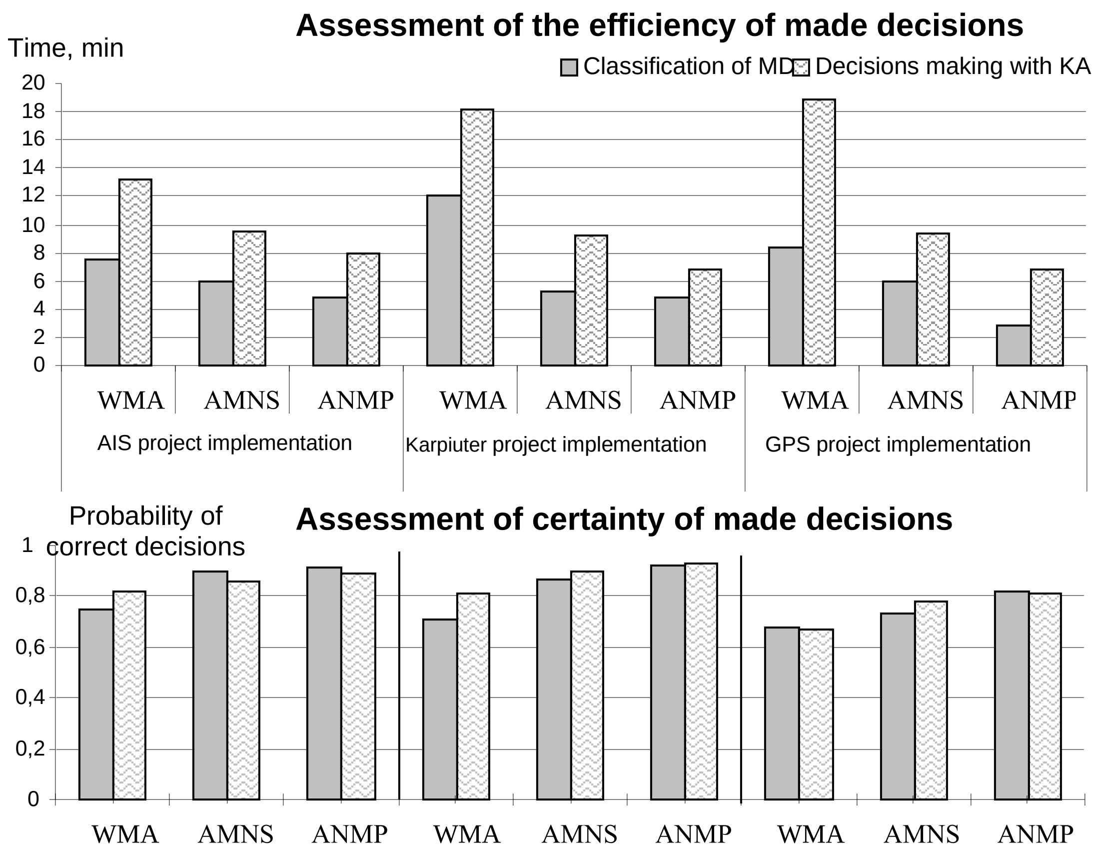
2) Data analysis (OLAP, Datamining, Text mining, Video mining, etc.), which reveals significant regularities in large data sets;

3) Documents circulation (Document Management), which keeps, archives, indexes, mark-ups and publishes text documents;

4) Network technologies – Internet, Intranet, etc.;

5) Corporate knowledge portals and so on.

The experiment was carried out on the basis of the automobile unit. The experiment was aimed at performing technical task that is, developing the automated information system and was carried out: without the use of any information system development tools, with the use of the Internet and the KMS use which is based on the proposed model of explicit knowledge management. The results of the experiment (Figure 3) show that the use of the developed knowledge management system has the ability:



WMA – without means of automatization; AMNS – automatization (electronic documents, WEB); ANMP – automatization (knowledge management method)

Figure 3. Results of the experimental check

to reduce the time for the development of a technical task in 1.4 times in comparison with the case without information system development tools and in 1.2 times – comparatively with automatization (electronic documents, WEB) approach (AMNS);

to increase the number of correct decisions in 1.8 times in comparison with the case without information system development tools and in 1.3 times – comparatively with automatization (electronic documents, WEB) approach.

IV. CONCLUSIONS

Thus, the model of explicit knowledge management in OTS has been developed. This model has been transformed on the basis of different approaches, taking into account the peculiarities of the operation of OTS units, namely the creation of a mechanism for obtaining knowledge by all interested parties regarding the management of OTS, the introduction of information technology, etc. With this aim, an additional element – an information and telecommunication system providing the knowledge management, which implements KMS on the basis of ontological approaches, is introduced into the model.

The proposed approach to the management of OTS allows eliminating the differences between OTS components regarding the content, features of application and knowledge of the subject area.

References

[1] B. Milner, *Innovation Development: Economics, Intellectual Resources, Knowledge Management*, Moscow, Infra-M, 2018, 624 p. (in Russian).
[2] I. Nonaka, Kh. Takeuchi, *Company – Knowledge Creator. Origin and Development of Innovations at Japanese Companies*, Moscow, Olympus-Business, 2003, 384 p. (in Russian).
[3] V. Z. Yampolskyi, A. F. Tuzovskyi, S. V. Chirikov, *Knowledge Management Systems (Methods and Technologies)*, Tomsk, Publishing House NTL, 2005, 260 p. (in Russian).
[4] B. Kogut, U. Zander, "Knowledge of the firm, combinative capabilities, and the replication of technology," *Organization Science*, vol. 3, issue 3, pp. 383-397, 1992, https://doi.org/10.1287/orsc.3.3.383.
[5] K. Wiig, *Knowledge Management Foundations*, Schema press, 1993, 475 p.
[6] G. Hedlund, "A model of knowledge management and the N-form corporation," *Strategic Management Journal*, vol. Spring, pp. 73-90, 1994, https://doi.org/10.1002/smj.4250151006.
[7] I. Nonaka, K. Takeuchi, *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, Oxford, 1995, 284 p.
[8] F. Nickols, *The Knowledge in Knowledge Management*, Distance consulting LLS, 2010, 8 p. [Online]. Available at: https://www.nickols.us/knowledge_in_KM.pdf.
[9] M. Mayer, M. Zack, "The design and implementation of information products," *Sloan Management Review*, vol. 37, issue 3, pp. 43–59, 1996.
[10] D. J. Skyrme, "Knowledge management solutions – The IT contribution," *ACM SIGGROUP Bulletin*, vol. 19, issue 1, pp. 34–39, 1998, https://doi.org/10.1145/276203.292488.
[11] M. Boisot, *Knowledge Assets: Securing Competitive Advantage in the Information Economy*, Oxford, UK, Oxford University Press, 1998, 312 p.
[12] M. Earl, I. Scott, *What on earth is a CKO*? Survey IBM, London Business School, 1998, 7 p.
[13] M. M. Crossan, H. W. Lane, R. E. White, "An organizational learning framework: From intuition to institution," *Academy of Management Journal*, no. 24, pp. 522–537, 1999, https://doi.org/10.5465/amr.1999.2202135.
[14] D. Snowden, "The ecology of a sustainable knowledge management program," *Knowledge Management*, vol. 1, issue 6, pp. 15–20, 1998.
[15] F. Soliman, K. Spooner, "Strategies for implementing knowledge management: Role of human resource management," *Journal of Knowledge Management*, vol. 4, issue 4, pp. 337–345, 2000, https://doi.org/10.1108/13673270010379894.
[16] M. Alavi, D. Leidner, "Knowledge Management systems: issues, challenges and benefits," *Communications of the Association for Information Systems*, no. 1, pp. 35–41, 1999, https://doi.org/10.17705/1CAIS.00107.
[17] H. Rollet, *Knowledge Management Processes and Technologies*, Norwell, MA: Kluwer Academic Publishers, 2003.
[18] M. Sağsan, B. Bingol, *From Learning Organization to Knowing Organization: A Practical View for Building 'Knowledge Shrine' with Four Minarets*, in Contemporary Issues in Management and Organizations (Ed.) Cengiz Demir, İzmir: Ekinyayınevi, 2010.
[19] G. Us, *Theoretical Bases and Problems of Knowledge Management in Social and Economic Systems: Monograph*, Cherkasy, Southern European University of Economics and Management, 2012, 327 p. (in Ukrainian).
[20] I. Becerra-Fernandez, R. Sabherwal, *Knowledge Management: Systems and Processes*, 2nd ed. Routledge, 2015, 382 p., https://doi.org/10.4324/9781315715117.
[21] O. Serrat, *Knowledge Solutions: Tools, Methods, and Approaches to Drive Organizational Performance*, Springer, 2017, 1098 p.
[22] Web Ontology Language. [Online]. Available at: http://www.w3.org/TR/owl-features/.
[23] T. A. Gruber, "Translation approach to portable ontologies," *Knowledge Acquisition*, no. 5(2), pp. 199–220, 1993, https://doi.org/10.1006/knac.1993.1008.
[24] V. V. Lytvyn, R. R. Darevych, D. H. Dosyn, "Intellectual systems of decision making support based on adaptive ontologies," *Artificial Intellect*, issue 3, pp. 388–395, 2011. (in Russian).
[25] A. Inkpen, A. Dinur, "Knowledge management processes and international joint ventures," *Organization Science*, vol. 9, issue 4, pp. 454–468, 1998, https://doi.org/10.1287/orsc.9.4.454.
[26] T. A. Gavrilova, "Establishment into ontological engineering," *Artificial intellect – problems and prospects. Politechnical reading*, issue 7, pp. 109–116, 2006. (in Russian).

OLEKSANDR ANDROSHCHUK*, a Professor of Cyber Security and Computer Networks and Systems Department, Doctor of technical sciences, Professor. Scientific interests: information technologies, artificial intellect.*

RUSLAN BEREZENSKYI*, Senior instructor of the Repair and Operation of Automobile and Special Equipment Department of the Faculty of Specialists of Material and Technical Support Training, PhD in technical sciences. Scientific interests: project management, auto technical maintenance.*

***OLHA LEMESHKO**, Deputy head of the Foreign Languages Department of the Faculty of operative and service activity support, PhD in pedagogics. Scientific interests: information technologies, foreign communicative competence.*

***ANDRIY MELNYK**, an Associate Professor of the Department of Computer Science of the Faculty of Computer Information Technology, PhD in technical sciences. Scientific interests: information technologies, ontology systems, computer science.*

***OKSANA HUHUL**, Head of the Department of International Tourism and Hotel Business of the B. Havrylyshyn Education and Research Institute of International Economic Relations, PhD in economic sciences. Scientific interests: information technologies, development of international projects and programs.*