INFORMATYKA EKONOMICZNA BUSINESS INFORMATICS 20 • 2011

ISSN 1507-3858

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A QUALITY EVALUATION MODEL OF COTS COMPONENTS ONTOLOGY IN MANAGEMENT INFORMATION SYSTEM DOMAIN

Summary: The main aim of this paper is to present an experiment of quality evaluation of author's COTS components ontology in Management Information System (MIS) domain. The available methods and tools for ontology evaluation are presented in details. The analysis of available methods and tools allows to select the most appropriate approach to verify the quality of presented ontology. Moreover the paper includes the adaptation of the OntoClean methodology for quality evaluation of COTS components ontology with the reference to MIS domain. Thus, the formal model of quality evaluation of the COTS components ontology is proposed. Furthermore the experimental tests for a given ontology were carried out. The conclusions finish this paper.

Keywords: ontology, methods and tools for ontology evaluation process, COTS software, Management Information System, COTS components selection.

1. Introduction

The World Wide Web has drastically changed during the last years. An increasing number of information available on the Web provides many difficulties and inconveniences considering the searching information from the Web resources quickly and in an efficient way as well. More often than not, some of obtained results do not provide sufficient information requested by a user. The purpose of semantic mechanisms application is to facilitate and enhance the retrieval information process from the World Wide Web resources. Nowadays the new idea of Internet is based on Web 3.0 approach (very often defined interchangeably in the literature as Semantic Web). It provides a wide range of possibilities of knowledge standardization and systematization about COTS software components (Commercial-Off-The-Shelf).

The knowledge representation using Semantic Web is largely based on ontologies. The ontologies offer a wide range of possibilities of application including shared understanding of many domains that can be transferred between both users (human beings) and application systems. The whole process of building an ontology requires a specified domain knowledge and is time-consuming as well. The general issue is also to provide possibilities of ontology reusing and updating, which decrease the

development of them from a scratch. Moreover one of the most important factors is a quality evaluation of a given solution and diminishing of any inconveniences if they already exist.

The general aim of the paper is to present and analyze available methods and tools supporting ontology evaluation. Then the best solution for ontology evaluation of COTS components in Management Information System (MIS) domain is proposed. Furthermore the general postulates for ontology supporting COTS components selection were defined including the specification of MIS domain as well. Available methods and tools provide a wide range of capabilities for ontology evaluation, including the quality measures, ontology rankings, suitability of the ontology to a given project, evaluating of knowledge representation for a particular domain and truthfulness of the ontology for a given domain. Moreover they enable automatic or semi-automatic procedure for the ontology evaluation. The main aim of selected methods and tools is to deliver a set of information about suitability of an ontology for a particular project or domain. Referring to COTS components ontology evaluation in MIS domain the OntoClean methodology was selected.

2. General establishments for the ontology for COTS components selection in MIS domain

Nowadays the World Wide Web is developed toward Semantic Web. Knowledge representation of a given domain is presented using ontologies to form and provide automatic recommendation Web services. One of the most frequent cited ontology definitions was proposed by Gruber in 1993. It defines the ontology as representation of shared understanding conceptualization [Gruber 1993]. The ontology is a representation of a domain application where particular concepts existing in a given domain are defined in explicit and formal way. Furthermore the ontology structure is a central research issue for Semantic Web. The ontology provides some possibilities for knowledge formalization that a human being has in a machine-readable way. Furthermore the aim of the ontology is to deliver a specified and complete classification of particular issues in every part of reality. Referring to COTS software, the ontology has to provide a systematic and repeatable solution for COTS components selection in MIS domain, including individual preferences of an enterprise.

COTS products are ready to sell products, available in many identical or similar copies and the vendor has a total control of the COTS software. COTS products can be a part of a bigger and more complex COTS – Based System (CBS). However, COTS products can differ from each other including products documentation. Furthermore a decision-maker does not have efficient knowledge about available component features. Moreover the difficulties with components integration can exist. In case of building an ontology for COTS components it is necessary to indicate how the ontology should be updated and how it provides automatic process in order to

ensure the explanations for particular resources that are obligatory for its continuous development.

The ontology for COTS components should provide mechanisms for updating the information about particular components and extracting the information about these components according to inquiries posed by a decision-maker. COTS products marketplace changes frequently and continuously, hence very often the producers and sellers of particular software lose control of the product and do not cope with updating the information about particular product or components. Furthermore, one of inconveniences referring to building the COTS components ontology is extraction of information about available components and their specification based not only on subjective information providing by vendors.

3. Selected methods and tools supporting ontology evaluation process

In the literature the unique definition of ontology evaluation process does not exist [Gangemi et al. 2005; Gilbert 2009]. During the ontology evaluation process both the quality and adequacy are defined referring to a particular domain especially with a precise goal of the appliance [Fernandez, Cantador, Castells 2006]. Thus it provides a technical opinion on ontology content, encompassing especially its requirements specification, content, meta-ontology and query possibilities. The general aim of an ontology evaluation is checking its appliance to a particular domain and also adaptation and reusing of that ontology in industry and WWW society [Alani, Brewster 2006; Gilbert 2009; Hartmann (ed.) 2005]. Moreover, there is a substantial lack of sufficient knowledge about specifications of user's requirements to select the most preferable ontology for a given task [Alani, Brewster 2006]. Nowadays many of available approaches provide an evaluation in a different context and on different levels of complexity. Gangemi et al. [2005] propose three types of ontology evaluation: functional, usability-based and structural. The first of them focuses on measuring how well a given ontology is serving its purpose. Usability evaluation is based on metadata and annotations. Then the structural evaluation focuses on structural properties of a given ontology. Another classification is presented by Brank et al. However, Brank et al. [Brank, Grobelnik, Mladenić 2005; Gilbert 2009] proposes a taxonomy of evaluation approaches that is based on a type and thought that adapt aspects of vocabulary, taxonomy, semantics relationships, applications, syntax, structure and project (Table 1).

Table 1 presents the selected approaches for ontology evaluation: gold standard approach, task based approach, data or corpus driver approach and user's opinion approach. These approaches differ from each other in a significant way.

Nowadays many approaches to ontology evaluation exist. The ontology evaluation and ranking can be based on including different kinds of criteria. Moreover, increasing number of ontologies cause the increasing number of reasoning and

Table 1. A taxonomy of ontology evaluation approaches

Approach	Features	Evaluation
Gold standard approach	Comparing the ontologies to pre-defined standard or other domain representation.	Standard definition in inappropriate way has a great influence on the quality of given results.
Task based approach	The ontology evaluation considering its appliance to particular tasks.	The difficulties with the quality assessment for a particular task. It is to ensure the neutral environment during the experimental evaluation process where any factors have not an influence on modification of application.
Data or corpus driver approach	It evaluates the congruence of an ontology with a given corpus to determine how appropriate it is for the representation of knowledge of the domain represented by the texts.	The content application is not possible.
User's opinion approach	The requirements are pre-defined by users.	Requirements verification depends on their pre-defined process by users. The higher specification process, the most difficult to cope with particular criteria.

Source: own elaboration on the basis of [Brank, Grobelnik, Mladenić 2005; Gilbert 2009].

searching mechanisms. The selected methods are based on the quality assessment of an ontology, clustering and arranging particular ontologies, adapting the ontology to a given project, evaluating the knowledge representation for a selected ontology and reliability of the ontology for a given domain. Additionally they provide automatic or semi-automatic mechanisms for an ontology evaluation process. The main aim of application of these tools is to deliver relevant information about applying the ontology both for a particular project and a domain. Table 2 presents selected approaches for ontology assessment considering different mechanisms, techniques and criteria.

Each of presented methods and tools provides the information about ontology evaluation in a different way, very often concentrating on a different kind of criteria. Some of them require a specified knowledge and training for the end-users. The application of a particular method or tool should be considered from three points of view: from the intendent usage viewpoint, from the application (or use case) viewpoint, and from the user viewpoint [Hartmann (ed.) 2005]. It is possible to use them both in academic purpose (for example OntoClean) and in industry (for example EvaLexon, OntoManager, NLAM etc.). On the basis of literature review and presented analysis it can be said that the OntoClean methodology focuses on the evaluation

Table 2. The selected methods and tools for ontology evaluation

Approach	Application	Evaluation
1	2	3
OntoQA [Tartir et al. 2005]	The general aim of this tool is to measure the quality of an ontology using appropriate schema and regular metrics. Schema metrics direct the ontology project, then regular metrics measure size and dislocation of regular data. Schema metrics are: Relationships Diversity (RD) and Schema Deepness (SD). RD is the ratio of the number of non-inheritance relationships, divided by the total number of relationships defined in the schema. It describes the diversity of relationships in an ontology. Then SD is the average number of subclasses per class. It indicates the distribution of classes across different levels of the ontology inheritance tree.	It enables knowledge engineers and researchers to find and analyze utility of ontologies in Semantic Web. This tool can be confirmed by comparing the given results both to other approaches and expert knowledge.
AKTiveRank [Alani, Brewster, 2006]	This tool supports ranking the ontology using Class Match Measure (CMM), Density measure (DM), Semantic similarity (SS) and Betweeneness measures (BM). It ranks the ontologies considering the number of classification metrics and it compares the results with the questionnaire provided by a user.	It can be matched and integrated with other different ranking systems to consider additional criteria.
OntoMetric [Lozano-Tello, Gomez-Perez, 2004]	The general aim is to support during the ontology selection process for a new project. It is MCDA method supporting knowledge engineers in defining the suitability of a given ontology to a particular project. A user selects an ontology considering such dimensions as: ontology content, implementation language, methodology development, software for building an ontology and costs of using a particular ontology into a system. It is based on AHP process. It enables the selection of the most suitable ontology from existing alternatives and decides about suitability of the ontology for a given project.	The appliance of AHP method requires from knowledge engineers comparing both the purposes of a particular project and precise characteristics exploration of given ontologies. For each of the candidates the quantity measures for their suitability are provided. It ensures the support during the decision-making process and provides information about advantages of a given solution. Additionally it estimates the risk referring to new ontology selection.
ODEval [Hartmann (ed.) 2005]	It is used by ontology designers to evaluate knowledge representation for ontologies implemented in Semantic Web languages before they will be used in applications. It allows the inconsistency implication in knowledge representation, deficiency and redundancy in concepts in any considered language. It requires user's involvement in evaluation process. It replenishes parsers and ontology platforms, which enables ontology evaluation in RDF(S), DAML+OIL and OWL languages. ODEval uses a set of algorithms based on graph theory.	The lack of detailed metrics for evaluated ontologies. It requires meaningful user's involvement. Moreover it is possible to use this tool to a finished ontology. It provides both a lexical support and support during the taxonomy evaluation process.
OntoManager [Stojanovic, Hartmann, Gonzalez 2003]	It is used by administrators, domain experts and business analytics to determine the truthfulness of an ontology including its appliance for given domain problems. Furthermore it helps in semi-automatics process of enhancing the ontology referring to the user's needs.	This tool is easy to implement and use for end-users. Moreover it characterizes a low quality of evaluation. It is possible to use after ontology application. It provides both a lexical support and support during the taxonomy evaluation process.

1	2	3
Natural Language Application metrics [Maedche, Staab 2001]	It is used for content evaluation of particular ontologies including applications based on natural language. The following metrics are provided: Precision and Recall Metrics, Cost-based evaluation metrics, Tennis Measure and Lexical comparison level measure. It delivers measures for every ontology how many items are correctly identified and how much of them are correctly identified. It allows comparing the content of two ontologies without considering their conceptual structure.	These methods are efficient for industry because they compare different systems. As a consequence it helps in matching between ontology and domain knowledge (or corpus knowledge). However, difficulties for a user considering the weight attributes or finding a way for accounting are possible.
OntoClean [Guarino, Welty 2002]	It is based on philosophical notations for formal evaluation of a taxonomy structure. It is concentrated on cleaning of a taxonomy and also it is used for cleaning the high levels of WorldNet taxonomy. The core of methodology are four basics ontological notations: rigidity, unity, identity, and dependence. By matching them as meta-relations to concepts in taxonomy they have to present the behavior of particular concepts.	It is possible to use this tool for finished ontology. It provides both a lexical support and support during the taxonomy evaluation. It requires an appropriate training before the method will be used and a broad domain knowledge or help from expert domain about particular ontology engineering.
EvaLexon [Spyns 2004]	The aim is to provide a simply and objective and fully automated evaluation procedure for ontology miners from text.	It is possible to use in industry. There are only a few methods for ontology mining and learning – thus the role of EvaLexon method is rising up. It is possible to apply in an existing ontology.
CORE [Fernandez, Cantador, Castells 2006]	It provides automatic similarity measures by comparing gold standards to other ontologies. This method implies integration of ranking techniques to explore ranking lists of ontologies for each of criteria.	It is possible to use after ontology application. It provides both lexical support and support during the taxonomy evaluation process.
CleanONTO [Sleeman, Quentin 2006]	The aim is to check the inconsistency in a given ontology and after then organize it into the consistency state as well. It ensures the acquiring a description for each concept removing improper connections. Further it organizes the ontology into a consistent tree hierarchy.	It is possible to use this tool for finished ontology. It provides both a lexical support and support during the taxonomy evaluation process.
OntoKBEval [Lu, Haarslev 2006]	The aim is to evaluate an OWL ontology using Description Logic support. The ontology evaluation is based on building corpus (core) hierarchical structure from TBoxes and ABoxes with specified information in a reference form and statistics analyses to another classification of DL KBE elements.	It is possible to use after ontology application. It provides both a lexical support and support during the taxonomy evaluation process.

Source: own elaboration on base of: [Tartir et al. 2005; Alani, Brewster 2006; Lozano-Tello, Gomez--Perez 2004; Hartmann (ed.) 2005; Stojanovic, Hartmann, Gonzalez 2003; Maedche, Staab 2001; Guarino, Welty 2002; Spyns 2004; Fernandez, Cantador, Castells 2006; Sleeman, Quentin 2006; Lu, Haarslev 2006; Gilbert 2009].

of formal aspects of ontologies and it enables the evaluation of ontology upper-levels as well [Hartmann 2005]. Thus, the proposal of a model of ontology evaluation of COTS components in MIS domain will be based on the OntoClean methodology.

4. The quality assessment of COTS components ontology for MIS domain

The process of quality assessment of ontology supporting COTS selection process in MIS domain can require the application of semantic techniques. The general aim of presented methods and tools is to provide a systematic and repeatable approaches which support COTS components process in MIS domain and help in quality assessment of an ontology. Hence, for quality assessment process of presented ontology in this paper the OntoClean approach was selected [Guarino, Welty 2002]. It is the methodology for validating the ontological adequacy of taxonomic relationships. The methodology is based on formal notions which can be used for a particular domain.

The general aim of the OntoClean methodology is to verify the COTS components ontology for ERP systems. Using Protégé Axiom Language (PAL) constraints tab, the whole process of evaluation has started. Generally it helps in cleaning the taxonomy. The core of the methodology are four basics ontological notations: rigidity, unity, identity and dependence [Hartmann (ed.) 2005]. These elements are attached as meta--relations to concepts in a taxonomy, hence in that way they are used to represent the behavior of concepts. The OntoClean is composed of a set of axioms that formalizes definitions, constraints and instructions of the OntoClean. Besides is contains meta--ontology viz. so-called taxonomy of properties that provides frames of references to evaluation process [Hartmann (ed.) 2005]. Moreover these building blocks are creating the basics infrastructure for OntoClean implementation. The OntoClean ontology can be compared with pre-defined an ideal structure of a taxonomy to find inconsistency [Guarino, Welty 2002]. Hence the OntoClean methodology integration allows to integrated quality control for ontologies.

Each of the OntoClean notions is borrowed from philosophy. The first of them, rigidity, is determined on the basis of idea of essence. A particular property of an entity is essential to that entity if it must hold for it. Hence, a property is rigid if it is essential to all its possible instances ($+R$). In the opposite, a property is non-rigid ($-R$) if and only if it is not essential to some of its instances, and anti-rigid if and only if it is not essential to all its instances ($\sim R$) [Hartmann (ed.) 2005; Guarino, Welty 2002]. These conditions are formally described below as follows:

- ϕ is rigid ($+R$): $\forall x\, \phi(x) \rightarrow \phi(x)$
- ϕ is non-rigid ($-R$): $\exists x\, \phi(x) \wedge \neg \phi(x)$
- ϕ is anti-rigid ($\sim R$): $\forall x\, \phi \quad (x) \rightarrow \neg \phi(x)$

According to presented conditions certain entities have essential properties. Hence certain properties are essential to all their instances and these properties are rigid if an entity is ever an instance of a rigid property, it must always be. Referring

these conditions to COTS ERP components ontology, every ERP system must have specified features of ERP systems (functional and technological criteria), which typically occur in every solution. For example, the System is rigid, then ERP is non-rigid and Comarch is anti-rigid.

The next of them, unity, refers to being able to recognize all the parts that form an individual entity. A property P is said to carry unity ($+U$) if there is a common unifying relation R such that all the instances of P are wholes under R. Besides a property is anti-unity if all its instances can possibly be non-wholes ($\sim U$) [Hartmann 2005].

An object *a is a whole* under ω if ω is an equivalence relation such that:

- $P(y, a) \wedge P(z, a) \leftrightarrow \omega(y, z)$,

but not:

- $\omega(y, z) \leftrightarrow \exists x(P(y, x) \wedge P(z, x))$,

and ω can be seen as a *generalized indirect connection.*

The identity criteria are the result of our conceptualization of reality. Hence, they are always related to the class of entities considered as relevant to the particular purposes. Thus the identity criteria are not the similarity criteria because it is possible only to define the sameness of particular ones. The notion identity (I) refers to the problem of being able to recognize all individual entities in the world as being the same (or different), Thus identity criteria are conditions used to determine equality (sufficient conditions) and are entailed by equality (necessary conditions). $+I$ notion means that the identity is carried then $+O$ defines supplying the identity.

Based on the *sameness* of a certain property:

- $\phi(x, t) \wedge f(y, t') \rightarrow ((c(x, z, t) \wedge c(y, z, t')) \leftrightarrow x = y)$,
- $t = t'$: synchronic; $t \neq t'$: diachronic.

Generalization:

- $\phi(x, t) \wedge \phi(y, t') \rightarrow (G(x,y, t,t') \leftrightarrow x = y)$.

The last of them, dependency, determines if both a particular entity can exist alone and if its existence implies the existence of something else (rigid dependence). Moreover, this notion provides information about a property dependence [Guarino, Welty 2002].

A property ϕ is dependent ($+D$) if:

- $\forall x\, \phi(x) \rightarrow \exists y\, \varphi(y) \wedge \neg P(x, y) \wedge \neg C(x, y)$.

If there is at least one instance of the property that is not dependent, the property is not dependent ($-D$). Besides it excludes qualities, entities that necessarily exist and subsumed properties.

A model of quality evaluation of COTS components ontology for MIS domain is presented on the basis of example of ERP COTS components ontology (broadly described in: [Konys, Wątróbski 2010]). In this example the criteria were selected randomly based on Computer World report for ERP systems.

The ontology was built using Protégé 4.1 program. The language which supports building of the ontology is OWL (Ontology Web Language). It provides both the

possibility for description of concepts and new additional functions for describing possible relationships. Each group of the criteria is referred to subclasses with a higher level of specification. The whole ontology is based on the structure of tree. The developed ontologies with a huge number of classes and complex inheritance almost always require the tree class hierarchy. The ERP COTS components ontology for MIS domain is described in details in [Konys, Wątróbski 2010].

The implementation of the OntoClean methodology to COTS ERP components ontology for MIS domain should provide the verification of the given ontology. Generally, it provides the analysis of an identification of a backbone taxonomy. The backbone taxonomy consists of all the rigid properties in the ontology, organized according to their subsumption relationships, and represents a view of the ontology showing all the most important properties – those that cover the entire domain – in this example for ERP COTS components it is a MIS domain [Guarino, Welty 2002]. Furthermore backbone properties are very important because they represent invariant, essential aspects in a particular domain (MIS domain for a presented example). Moreover the OntoClean methodology enables to identify the inconsistencies in considered ontology.

The appliance of the OntoClean methodology requires some conditions to satisfy. The next step encompasses the installation of PAL Constraints Tab. Further the metaclass should be changed of each of top-level classes and their subclasses to "Ontoclean_property". However it is possible to define the types of classes (quasi-type, a phased sortal, etc., as it was presented in the Table 3). The constraints were verified by using PAL Constraints Tab). As a result the inconsistency and the violations of the ontology were detected. The first of them refers to the defined class in the COTS ERP ontology – Sales system. The constraints defined for Sales system class should be changed (the constraint: $\sim U$ subsumes $\sim U$ is not possible) or replaced by different ones. Similar situation occurs in SupplyChainManagement class: the constraints should be more specified because they provide wrong results.

The obtained results are limited because it is only a part of bigger ontology for COTS components in MIS domain. The bigger ontology the better and more precise results are. The application of the OntoClean methodology for COTS components ontology provides a formal, consistent and straightforward way to explain some of the most common misunderstandings in conceptual modeling regarding the taxonomic or subsumption relation [Guarino, Welty 2002] with reference to MIS domain.

5. Conclusions

The main aim of this paper is to present a model of quality evaluation of COTS components ontology in MIS domain. The characteristics of available methods and tools for ontology evaluation were described in details. On the basis of analysis of presented methods and tools the OntoClean methodology was selected for evaluation of the COTS components ontology. The OntoClean methodology focuses on the

evaluation of formal aspects of ontologies and it enables the evaluation of ontology upper-levels as well. These criteria have an important meaning for COTS components ontology evaluation process. Hence, the application of the OntoClean provides both the formal verification and formal, consistent and straightforward way to explain some of the most common misunderstandings of analyzed ontology in MIS domain. The further researches will encompass the building a large COTS components ontology with reference to MIS domain and the evaluation and verification the results using the OntoClean methodology as well.

References

Alani H., Brewster C., *Metrics for ranking ontologies*, [in:] Proceedings of the 4th International Conference on Evaluation of Ontologies for the Web, EON Workshop, Edinburgh International Conference Centre, Edinburgh, UK, 2006.

Brank J., Grobelnik M., Mladenić D., *A survey of ontology evaluation techniques*, At the Conference on Data Mining and Data Warehouses SiKDD, Slovenia 2005.

Fernandez M., Cantador I., Castells P., *CORE: A tool for collaborative ontology reuse and evaluation*, [in:] Proceedings of the 4th International EON Workshop (EON 2006) at the 15th International World Wide Web Conference (WWW 2006) 2006.

Gangemi A. et al. (eds.), *A theoretical framework for ontology evaluation and validation*, In Proceedings of SWAP 2005, the 2nd Italian Semantic Web Workshop, CEUR Workshop Proceedings.

Gilbert M., *A flexible biomedical ontology selection tool*, "International Journal of Computing and ICT Research", Special Issue, 2009, vol. 3, no. 1.

Gomez-Perez A., *Ontology Evaluation*, [in:] *Handbook on Ontologies in Information Systems*, *First Edition*, Staab S., Studer R. (ed.), International Handbooks on Information Systems, Springer, Berlin 2004.

Gruber T.S., *A translation approach to portable ontology specifications*, "Knowledge Acquisition" 1993, vol. 5.

Guarino N., Welty C., *Evaluating ontological decisions with OntoClean*, "Communications of the ACM" 2002, vol. 45, no. 2.

Hartmann J. (ed.), *Methods for Ontology Evaluation*, EU-IST Network of Excellence NoE IST-2004--507482 KWEB 2005.

Konys A., Wątróbski J., *A model of ontology supporting COTS components selection process in Management Information System domain*, [in:] H. Dudycz, M. Dyczkowski, J. Korczak, *Advanced Information Technologies for Management AITM'2010*, Research Papers of Wrocław University of Economics No. 147, Wrocław 2010.

Lozano-Tello A., Gomez-Perez A., Sosa A., Selection of Ontologies for the Semantic Web, *LNCS* 2004, Vol. 2722.

Lu Q., Haarslev V., *OntoKBEval: DL-based Evaluation of OWL Ontologies*, [in:] Proceedings OWLED, IEEE 2006.

Maedche A., Staab S., *Ontology learning for the Semantic Web*, "IEEE Intelligent Systems" 2001, vol. 16 (2).

Sleeman D., Quentin R., *CleanONTO: Evaluating taxonomic relationships in ontologies*, 4th International EON Workshop, Edinburgh International Conference Centre, Edinburgh, UK 2006.

Spyns P., Pretorius A.J., Reinberger M.L., *Evaluating DOGMA-lexons generated automatically from a text corpus*, [in:] Ph. Cimiano, F. Ciravegna, E. Motta, V. Uren (eds.), *Proceedings of the EKAW*

2004 Workshop on Language and Semantic Technologies to Support Knowledge Management Processes, pp. 38-44, 2004.

Stojanovic N., Hartmann J., Gonzalez J., *The OntoManager – a system for the usage-based ontology management*, [in:] Proceedings of FGML Workshop, SIG of German Information Society, Springer-Verlag, 2003.

Tartir S., Arpinar I., Moore M., Sheth A., Aleman-Meza B., *OntoQA: Metric-Based Ontology Quality Analysis*, [in:] *IEEE Workshop on Knowledge Acquisition from Distributed, Autonomous, Semantically Heterogeneous Data and Knowledge Sources*, IEEE Computer Society, Los Alamitos 2005.

MODEL OCENY JAKOŚCI ONTOLOGII WSPOMAGAJĄCEJ PROCES WYBORU SKŁADNIKÓW COTS W DZIEDZINIE SYSTEMÓW INFORMATYCZNYCH ZARZĄDZANIA

Streszczenie: Celem niniejszego artykułu jest próba oceny jakości autorskiej ontologii składników COTS w obszarze Systemów Informatycznych Zarządzania (SIZ). W tym celu dokonano szczegółowej analizy dostępnych metod i narzędzi wspierających ocenę ontologii. Umożliwiło to wybór narzędzia weryfikującego jakość opracowanej ontologii. W części autorskiej zaadoptowano metodologię OntoClean na potrzeby oceny jakości ontologii składników COTS w odniesieniu do dziedziny SIZ. Opracowano postać formalną samego modelu oceny jakości oraz przeprowadzono badania eksperymentalne dla wskazanej ontologii. Całość kończą wnioski z przeprowadzonych badań.

Słowa kluczowe: ontologia, metody i narzędzia procesu oceny ontologii, oprogramowanie COTS, systemy informacyjne zarządzania, wybór składników COTS.