# Mereological Approach for Formation of “Part-Whole” Relations between Pages of a Semantic Wiki-resource

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**Abstract**

Wiki technologies are considered as a common means of collaborative development of information resources. One of the most typical problems that arise in the process of semantization of the Wiki resources with a complex heterogeneous structure is the construction of consistent and non-contradictory set of semantic properties that represent the meanings of relations between individual Wiki-pages.

We propose to use elements of ontological and mereological analysis that allow us to formalize the characteristics of the used semantic relations and to determine their subtypes. Thus, the interoperability of the use of the names of semantic relations by independent and territorially separated users with different terminological systems is ensured. Mereology analyzes one of the fundamental types of relations between objects, as well as natural and artificial environments – the relations of part and whole. The main subtypes of mereological relations are considered on the examples of relations between the pages of e-VUE – portal version of the Great Ukrainian Encyclopedia implemented on base of semantic Wiki technologies.

**Keywords**

wiki-resource, semantic relations, mereology, ontology



## 1. Introduction

Today it is quite difficult to ensure in practice the joint, free and open use of information. Problems caused by large volume, heterogeneity, distributed sources and inconsistency require a new specialized approach which would ensure a balance between the openness of information and its uncontrolled distribution. Open Source Intelligence (OS-INT is aimed at the collective gathering and analysis of information [1]. It is a knowledge-oriented area of the Open Source concept [2] which becomes an increasingly significant source of knowledge because of increase the number of Web users and the improvement of their qualification.

OS-INT includes social networks, Wiki-resources, blogs, etc., that are created and added to by millions of the Web users. Such resources has some structure elements and so they can be considered as semi-structured ones, but their structure is often quite contradictory and incomplete for automated processing.

Main principles of OS-INT joint work are peer review, the practice of mutual evaluation by experts of their own work, the predominance of independent reputation over administrative control, free circulation of products, and flexible levels of dependence and responsibility. Evaluations performed by reputable specialists are more important for communities. Knowledge is acquired in the process of clarifications and reaching consensus.

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OS-INT consists of various independent projects that have different histories, different technical and social strategies for implementation of open source sharing principles.

Now OS-INT has a strong theoretical and technological basis. Many information technologies are created to facilitate the free and accessible exchange of information between experts, and information is not only effectively disseminated, but also jointly evaluated. The simplest OS-INT platforms – mailing lists (e-mail lists) – appeared in the mid-70s of the last century. In the 80s, FidoNet and Usenet proposed users some OS-INT capabilities, but they were quite difficult to use. In the 1990s, many of these platforms were transformed by the advent of the World Wide Web.

One of the most common areas of current OS-INT is Wiki-technology [3]. Now this technology is actively used for the development of knowledge management systems in various fields, for example, for development of Wikipedia [4]. Software and content contained on Wiki pages most often use the GNU Free Documentation License (GFDL), which guarantees compatibility of the license with the existing body of GFDL texts. This makes it possible to use one Wiki with pages that are based on different licenses.

*Wiki-environment* is a hypertext environment (usually it is a Web-site) that allows users to create and modify its content in some rather simple way. The site content that consists of individual Wiki pages and links between them is called a *Wiki-resource*. Creation and editing of Wiki-resource is a collective process. Since the process of revision and clarification is public and continuous, there is no fundamental difference between preliminary and final versions of Wiki-resource information. The use of the expert review principle of open sources allows the Wiki-resource to gradually grow both in terms of the number of articles and their depth and quality due to the collective contribution of users specializing in certain issues.

Wiki-technology is a technology for Wiki-resource building. It allows visitors of the Web site to participate in content editing – correction of errors and addition of new materials without special software and without registering on the site. Such operations do not require learning the HTML language or special query languages. Basic Wiki-technology is not oriented on processing of semantics but can be used for these purposes with a help of various extensions.

Semantic MediaWiki (SMW) is one of the common engines for creating and maintaining Wiki-resources that provides semantization of information into Wiki-resource, reuse of knowledge and consistency of content [5]. SMW is a semantic extension of MediaWiki [6], a free and open source software for the hypertext Wiki-environment that provides a platform for creating directories, encyclopedias and catalogues. SMW allows users to add semantic properties to Wiki pages, turning Wiki-resources on base of MediaWiki into some kind of knowledge base.

Advantages of SMW use:

- Integration of information from different Wiki pages in various lists and tables that are generated automatically by results of semantic queries;
- Visualization of information (for example, with the help of additional plug-ins, such as Semantic Result Formats and Semantic Maps) that can represent information as maps, calendars, graphs, etc.;
- Convenience of structured information input by use of semantic templates and forms;
- Personalized information search – users can search for information relevant for their individual needs by generation of specific queries with the help of SMW add-ons like Halo and Semantic Drilldown;
- Consistency of data in different languages and from different Wiki-resources;
- Ability to reuse information in other applications – data created in SMW can be easily transferred externally in CSV, JSON, and RDF [7] formats, and by use of External Data and Semantics Result Formats it is possible to transfer data from one Wiki-resource to another, eliminating the need for duplication and manual synchronization;
- Integration with Semantic Web technologies – for example, the Triple Store Connector extension allows to connect Wiki-resource with RDF repositories and to use the SPARQL language for queries.

All these advantages are based on complex knowledge structure of domain that is represented by Wiki-resource. Adequacy and pertinence of domain knowledge representation require relevant semantic elements of Wiki-resource. One of the main problems that arise in the process of creating a semantic

Wiki-resource with complex heterogeneous structure is the construction of a set of semantic properties that allow to display correctly the relations between individual Wiki-pages. It is important to avoid both the use of different names for relations with the same meaning, and the use of the same names to display relations with different semantics (this situation can be caused by the ambiguity of the terminology of different domains).

The built-in means of SMW do not allow formal representation of the characteristics of semantic properties (such as equivalence, transitivity, reflectiveness) and their range of values and range of definition. Therefore, it is advisable to use elements of ontological and mereological analysis to solve this problem and formalize these characteristics in an interoperable way.

## 2. Formulation of the problem

The purpose of this work is to develop methods and means for correct and to define unambiguously semantic relations between pages of Wiki-resource. Such information from the point of view of semantic technologies can be considered as classes and instances of ontology classes but we need in models and methods for matching of elements of ontology with elements of semantic Wiki-resource. The most important of them are basic relations between domain concepts represented by different expressive means. We proposed to use mereological analysis as a basis for a more clear and interoperable definition and differentiation of various subtypes of "part-whole" relations. This should ensure a more efficient search for information into the Wiki-resources and give users faster access to content elements that they need.

## 3. Relevance of the problem

The semantization of Wiki-technologies provides an opportunity to define explicitly relations between Wiki-pages, but each domain (and, accordingly, each information resource (IR) that deals with this domain) is defined by fixed set of domain-specific relations. Some domain relations are the same for all areas (for example, "class-subclass"), and some others are very specific and are used for individual domains only and have no formally defined characteristics (for example, relation "has journal publications").

However, we can assign a group of relations of the "part-whole" type which are characteristic for various domains, but contain different subtypes with similar characteristics and different semantics. Their definitions make an important component of the description of various domains [8]. The theoretical basis for determining such subtypes is mereology – a scientific direction that formalize relations between parts and the whole. In the creation of modern Wiki-based encyclopedic IRs, focused on functioning in the Web and interaction with other intellectual applications, it is advisable to use this theoretical basis to expand the functionality of such IRs.

## 4. State of problem study

Mereology (from the Greek "part" and "study") is a formal theory about parts and concepts related to these parts. This theory is developed by S. Lesnevsky (Lviv-Warsaw school of mathematics), who analyzes the philosophical, logical and mathematical components of the foundations of mathematics [0]. The main object of mereology is the study of the "part-whole" relations. Mereology analyzes the connection of part and whole that is one of the main types of connection between objects, as well as natural and artificial environments [10]. It is the first of the logical systems created by S. Lesnevsky in 1916. Lesnevsky considered mereology as a part of the triad of deductive theories, which also includes protothetics and ontology (Lesnevsky names "ontology" a system with single relation "is_a" that differs from the modern Semantic Web approach). In this approach mereology consists single original relation – «to be an element". This theory was developed by K. Aidukevich, A. Tarsky, and T. Kotarbinsky [11]. The world scientific community considers the Lviv-Warsaw school as one of the directions of analytical philosophy [12]. A characteristic feature of their philosophy is a critical analysis of postulates, statements and used linguistic means with their mandatory logical verification.

The importance of «part-whole" relation is caused by its use as a basic concept of scientific knowledge. The system is a structural connection of its elements. Its basic formal characteristic is that elements do not simply enter the system, but enter it as a result of interaction with other elements.

The most common relations in real domains are:

- equivalence relation,
- taxonomic relation,
- structural relation,
- dependency relation,
- topological relation,
- cause and effect relation,
- functional relation,
- chronological relation,
- similarity relation,
- conditional relation,
- target relation.

However, not all of these ontological relations are equal, and we can single out in this set of relations the most fundamental ones – relations of taxonomy and mereology. While the term "taxonomy" is quite widespread and does not require additional definition, the term "mereology" is used much less often in research related to information technologies and therefore needs additional explanation that we propose in this research work.

Some relation is called *fundamental* if it can be used as a base of formal system with main mathematical concepts. There are four fundamental relations of mathematics:

- the membership relation (ZF and NF set theory),
- the relation between a function, its argument and the result (von Neumann set theory),
- the naming relation ("is_a" of Lesnevsky ontology),
- the relation "part-whole" (mereology).

Set theories are concentrated on belonging relations between a set and its elements. As opposed to them, mereology considers various meronomic relations between entities that are closer to set inclusion relation.

Different approaches differ in axiomatic definition of mereology but all of them have such hypothesis about properties of "part-whole" relation:

- every object is a part of itself (reflexivity),
- every part of a part of a whole is itself a part of that whole (transitivity),
- two separate objects cannot simultaneously be part of each other (antisymmetry).

The basis of T. Kotarbynsky's metaphysical research is Lesnevskyi's ontology, which he used to formalize the basic laws of existence.

This ontology consists of two categories, the theory of names, as a rule, is intended to express a two-category ontology. The theory of names with one category, represented by Lesnevsky's ontology axiom, is related to one-categorical ontology, which is caused by the nominalism of its author. However, Lesnevsky does not say anything about the nature of things existing in the world according to this ontology. Lesnevsky's ontology is a formal ontology in the nominalist version, where all objects are individual, single objects. Kotarbynsky's ontology is something more, because it talks about what individuals are (according to Kotarbynsky, they are things). Kotarbynsky called his ontological concept rheism, in which over time he began to distinguish rheism in the ontological sense and in the semantic sense). Ontological realism is based on two statements:

- (P1) every subject is a thing;
- (P2) no object or state is a relation or a property.

Both statements are formulated in the language of Lesnevsky's ontology, that is, assuming that the binding "is" has the main meaning determined by Lesnevsky's ontology axiom.

Kotarbynsky considered things as bodies that has temporal and spatial characteristics. This decision was motivated by the ideas of Lesnievskii and primarily by the mereological concept of class. An individual subject is considered by Kotarbynsky to be not only a single subject, but also an aggregate consisting of such single subjects, that is, a class in the mereological sense.

Following Lesnievskii, Kotarbinsky accepted the existence of mereological sets, not distributive sets. He believed that the definition of things as bodies would agree with the mereological interpretation of sets. Kotarbynsky defines the semantic nature of names: names are expressions that can be subjects or predicates of sentences, denoting things or personalities.

Mereology is not a logical theory, but a doctrine of parts. Its features can be analyzed in comparison with the distributive theory of sets. Statement “x belongs to the set X” (in the distributive sense) means only that x has the property X. In the mereological sense, the set is a "whole" or a collective aggregate, that is a completely defined physical object representing a composite of parts. For example, Ukrainian society as a mereological set consists of people living in Ukraine, of various social groups that make up Ukrainian society and, finally, of this society itself. Consequently, every one-element set is identical with the element itself, that the set X can be identical with the set Y, but X and Y may in the general case be the names of different objects. There are no empty sets in mereology, and the relation "part of” is a transitive relation for mereological sets and not transitive for distributive sets.

Ontology is related to mereology and can be analyzed as syntactic framework of the mereology without such clarifying terms as "subject".

In mereology, the relation "part-of" has the following properties:

1. Asymmetry: $(x << y) \Rightarrow \neg(y << x)$ ;
2. Transitivity: $(x << y) \wedge (y << z) \Rightarrow x << z$ .

The system is a structural combination of its elements. Basic formal characteristic of system is a result of interaction with other elements and can’t be reduced to properties of elements. The four-digit relation *M (a,b,c,s)* means that in the system *s* the element *a* is connected to the element *b* by means of the relation *c*, which is usually denoted as $a \xrightarrow{c} b$ , if *S* is clear from the context, and *c* connects only these two elements.

For mereology the *axiom of volume* is fulfilled: systems that connect the same objects in the same ways are equivalent.

The main axioms of mereology:

Axiom 1. There is an empty system $\exists s \forall x, y, c \neg M(x, y, c) = \varnothing$ □, and such a system is unique.

Axiom 2. A system that has at least one part is itself a proper part: $\forall s(\exists x, y, cM(x, y, c, s) \Rightarrow \exists zM(s, s, z, s))$ □□.

Axiom 3. If two objects can have several different connections, then the presence of an empty connection denies the possibility of any other connection: $\forall x, y, s(M(x, y, \varnothing, s) \Rightarrow \forall c(M(x, y, c, s \vee M(y, x, c, s) \Rightarrow c = \varnothing)$ .

Mereology has some other axioms that define specific relations between the general system and its elements and parts.

All mereological relations can be separated into such subclasses:

- Component-Object;
- Member-Collection;
- Part-Mass;
- Material-Object;
- Property-Activity;
- Stage-Process;
- Locality-Region.

Most studies of “part-whole” relations are devoted to the study of parts, but different types of wholes can be identified according to the following properties:

- Is it a separate part from the whole? ("melody-song" or "wagon-train").
- Is part spatial or temporal? ("room-apartment" or "winter-year");
- Does the part play a certain functional role in relation to the whole? ("engine-car").
- Are the parts indivisible? ("atom-molecule").

## 5. Specifics of formalization of the Web complex encyclopedic IRs

For creation of IR with complex structure of knowledge and large number of various information objects (IOs) and their classifications (such as encyclopedic IRs) we need to create a formal domain specification that clearly defines types of relations between individuals and classes. Incorrect classification of IO can negatively affect the quality of information and lead to its incorrect interpretation by users. Therefore, we analyze the use of mereologic elements for development of encyclopedic IR based on semantic Wiki-technology: semantic properties and their processing are used as software realization of mereologic categories, but embedded possibilities of Semantic MediaWiki are not enough for describing such complex structures.

Important part of development of encyclopedic resources deals with approaches to instruments and models of the Web publication. Now popularity of online encyclopedias is caused by their accessibility, adaptive user-oriented interface and content actuality.

The use of modern knowledge management technologies in the Web provides users with much more opportunities for analyzing and retrieval of information. Unfortunately, even the most advanced and popular online encyclopedias, usually, do not explore the methods and means of knowledge management that become the standard for other types of intelligent Web-applications. For example, the widely known Wikipedia is based on Wiki-technologies, but does not use their semantic extension. As a result, the knowledge contained in such IR cannot be processed by modern means of data analysis. This significantly narrows both the functionality of the encyclopedic editions themselves and the scope of their use. But the choice of means of semantization of Wiki-technologies is a separate scientific problem that has to take into account the specifics of user task and domain structure [13].

The portal version of the Great Ukrainian Encyclopedia (e-VUE – vue.gov.ua) is an OS-INT resource that uses the open source MediaWiki technological platform [14] and its semantic extension SMW, which provides a formal definition and processing of the content of links between Wiki-pages, taking into account the Semantic Web standards [15].

SMW as a semantic extension of the Wiki-technology allows to define the semantic properties of such IOs as individual Wiki-pages that correspond to the terms of the domain described in the encyclopedic IR, and users can see semantic properties of encyclopedic articles and search them by values of these properties. From the point of view of information technology, the main advantage of e-VUE compared to competing online encyclopedias and reference books (and for most users it is Wikipedia) is semantization, that is, the representation of data processing and analysis at the level of semantics. It is very important that semantic properties explicitly define meaning of relations between e-VUE articles for automated processing. The semantic property is inserted into the text of the Wiki-page in the format *[[name::value]]*. This syntax is very similar to regular Wiki-links to other pages.

If IOs are connected by non-semantic links then user needs to read the text of the pages, analyze the context of the link and try to determine its content on his/her own. If IOs contain semantic links then their content is defined clearly, unambiguously and uniformly – one name should be used for all properties with the same content.

e-VUE uses templates for *typical information objects* (TIO) – pages with the same or a similar set of semantic properties (with same sets of properties, but not their values). It is important to create a semantic property, define its name and type, and only then use it in the Wiki-pages. Development of complete and consistent system of such properties is one of the labor-intensive components within the development of the encyclopedic IR knowledge base structure.

The use of ontological analysis for the construction of types of e-VUE IOs allows us to define the semantics of these types, determine the relation between them, analyze which types of IO are redundant or duplicate each other, and which ones need to be added. In addition, ontology clearly defines the semantics of relations between types of IOs that correspond to typical schemes of e-VUE articles from different areas of knowledge.

For example, typical schemes of articles from the field of "geographical sciences" contain the following TIO:

- Article about an independent state;
- A unit of the administrative system of an independent state;
- An article about a foreign city: the capital / the center of an administrative unit / a large city;
- Article about the administrative region of Ukraine / Autonomous Republic of Crimea;
- An article about Ukrainian city;
- Article about the continent.

This classification corresponds to the methodology of e-VUE development, but may cause certain difficulties in the search process. Elements of this classification and analysis of the relevant articles content provide the set of TIOs for geographic IOs of e-VUE (this is not a complete list but an illustration of the proposed approach):

- Continent;

- State;
- City;
- Region;
- The capital of the state.

In this set we join such IOs as foreign and Ukrainian cities because such articles have similar structure.

Currently, e-VUE has a large number of semantic relations of various levels and types. Ontology that represents links between individuals of these TIOs as object properties contains two object relations (Fig.1):

- "applies to": "geographical sciences" → "geographic object";
- "located in": "geographical object" → "geographical object".

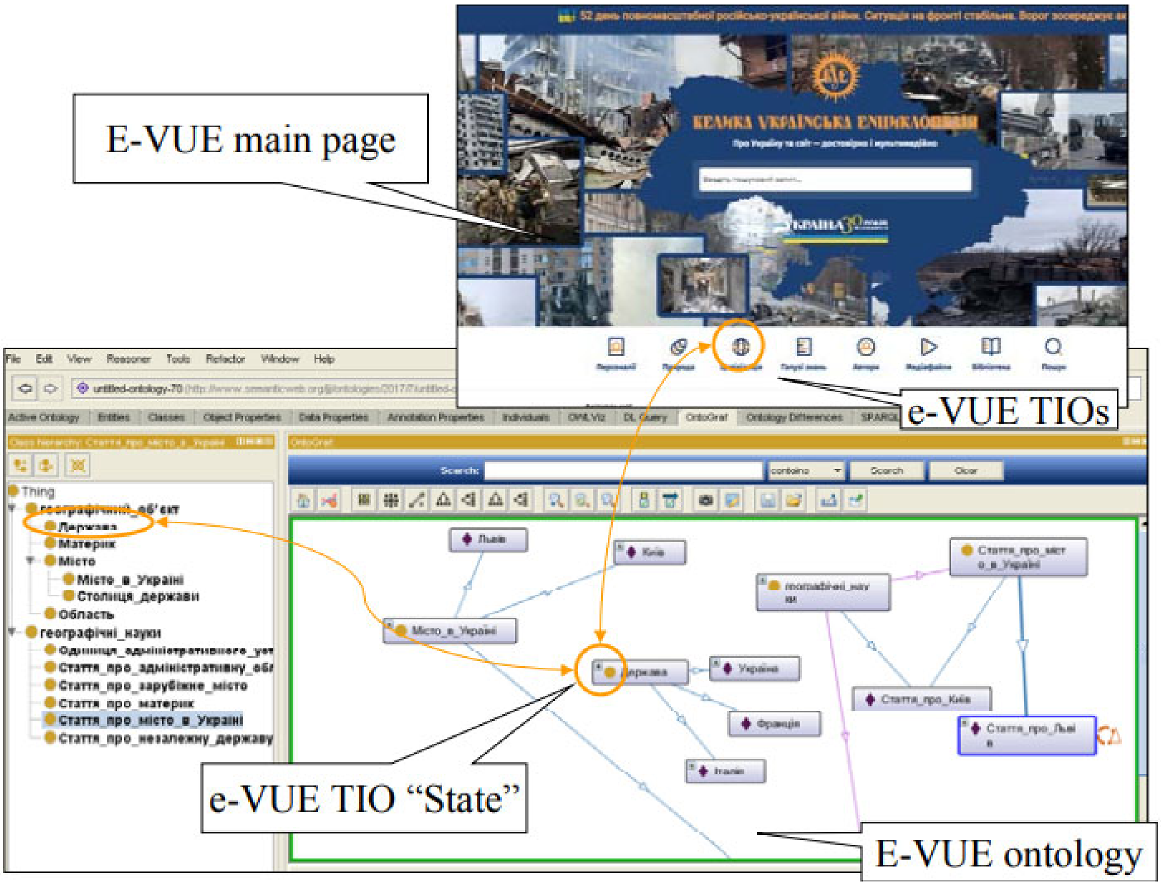


**Figure 1**: E-VUE ontological model (fragment that describes geographic IOs)

Such visualization of ontology structure is very useful for understanding of domain representation into IR. Although encyclopedia developers specializing in this domain know the relations between these IOs, but the use of ontology unifies relation names. Ontology allows users to represent a structure of categories and semantic properties that can be used in queries. Moreover, some other groups of users (for example, children) require information about such domain rules that, for example, a region is part of a state, and division into continents does not coincide with administrative boundaries.

## 6. Matching of domain ontologies and semantic Wiki-resources

The ontological model of the semantic Wiki-resource has more impressive possibilities for domain knowledge representation in comparison with Semantic MediaWiki build-in functional. But use of this model requires means for matching of ontology components with elements of Wiki-resource to support their relevance.

Semantic differences between Wiki-resources and their ontological models arises in several cases.

First, when creating semantic Wiki-resources, it is necessary to form a set of categories and semantic properties. But the built-in tools of Semantic MediaWiki do not allow us to formalize their characteristics, to visualize this information and to evaluate its integrity and consistency. Therefore, if some domain is represented by Semantic MediaWiki then it is advisable to build an ontology of this domain and then use this ontology as a basis for semantic markup of the Wiki pages: appropriate categories and semantic properties are created on base of ontology.

Secondly, semantically marked Wiki-resources are much more dynamic compared to ontologies – a wide range of users can participate in their improvement and restoration, and therefore they can be useful for improving the relevant domain ontology. If semantic Wiki-resource contains some additional relations between elements of content then ontological model can be enriched by appropriate knowledge.

Therefore, we require means that provide changes of ontology caused by changes of Wiki-resource structure and vice versa. We use formal model of ontology O = < X, R, F > where X is a finite non-empty set of domain concepts of ontology that can be divided on classes and individuals; R is a finite non-empty set of relations between ontology individuals; F is a finite set of axioms and interpretation functions for these concepts and relations [16]. Structure of semantic Wiki IR is represented by categories $P_{categ}$, semantic properties (data properties and object properties) $P_{sem\_prop\_page}$, non-semantic hyperlinks $L = \{"link"\}$, templates of TIOs $P_{template}$ and Wiki-pages of their individuals $P_{user}$. We have to define correspondences between elements of semantic structure of Wiki and elements of domain ontology that characterizes this structure (see Table 1).

**Table 1**

Correspondences between the main elements of ontologies and Wiki-resources

| Semantic MediaWiki | Ontology | From Wiki to ontology | From ontology to Wiki |
|---|---|---|---|
| Category $P_{categ}$ | Class $X_{cl}$ | One-to-one $P_{categ} \to X_{cl}$ | One-to-many $X_{cl} \to P_{categ} \cup P_{template}$ |
| Category Hierarchy | Class Hierarchy | one-to-many | One-to-one |
| Wiki-page $P_{user}$ | Class individual $X_{ind}$ | one-to-many $P_{user} \to X_{ind}$ | One-to-one $X_{ind} \to P_{user}$ |
| Link to Wiki page $L = \{"link"\}$ | Object property R | One-to-one $L = \{"link"\} \to R$ | One-to-one $R \to L = \{"link"\}$ |
| Semantic property of "page" type $P_{sem\_prop\_page}$ | Object property $\{r_i\}$ | One-to-one $P_{sem\_prop\_page} \to \{r_i\}$ | One-to-one $\{r_i\} \to P_{sem\_prop\_page}$ |
| Semantic property differed from "page" type $P_{sem\_prop}$ | Data property $\{p_i\}$ | One-to-one $P_{sem\_prop} \to \{p_i\}$ | One-to-one $\{p_i\} \to P_{sem\_prop}$ |
| Template $P_{template}$ | Class $X_{cl}$ | One-to-one $P_{template} \to X_{cl}$ | One-to-many $X_{cl} \to P_{categ} \cup P_{template}$ |

It should be noted that in many cases it is necessary to define properties more specifically, because their characteristics, such as symmetry and transitivity, act only within a certain subset of elements connected by properties of the same type. For example, the transitive mereological property "is a component" or symmetric property of semantic similarity. Let us consider the following illustrative example: humans are members of a political party, and arms and legs are parts of a human body, but we do not say that political party contains arms and legs. It is clear for human understanding, but not for machine processing. Therefore, it is advisable to define more accurately separate subtypes of various semantic properties while creating an encyclopedic publication intended for the Web. In this work, this approach is based on the application of 7 types of mereological relations (Table 2), which specify the content of the "part-whole" relation, but in the future, similar actions have to be performed for semantic properties of other types. It is important to note that due to universality in e-VUE, not a single hierarchy of mereological properties is used for connections between concepts, but a constantly expanding set of independent hierarchies – for example, the same personality can be an element (part) of a scientific school, a political party, a resident of a country or cities, etc.

**Table 2**
Subtypes of mereological properties in e-VUE:

| Property type | Property | Inverse property | Example |
|---|---|---|---|
| Component-Object | «is a component» | «has component» | Wing – plane |
| Member-Collection | «is an element» | «has element» | region-country |
| Part-Mass | «composes» | «contains» | Attribute – Database |
| Material-Object: | «is a material» | «includes» | aluminum – plane |
| Property-Activity | «is used» | «use» | Authorization – authentication |
| Stage-Process | «part of process» | «has stage» | Personal identity – Social empowerment |
| Locality-Region | «is located in» | «is a place of» | Transcarpathia – Ukraine |

To create semantic properties in Semantic MediaWiki, a special page "Create property" is used in e-VUE (Figure3). Semantic MediaWiki allows us to specify the name of a semantic property, its type (e.g. page, text, or number), as well as a brief definition and description of the property's scope.

Examples of semantic properties developed for formalization of mereological relations: “is a part (component)”, “is part of (member)”, “is part of (material)” and their inverse ones: “has part (object)”, “has part (collection)”, etc.

Inverse properties are not explicitly supported in Semantic MediaWiki, so to define semantics of inverse link between pages we need to create such inverse property separately. For example, the inverse one of the mereological property "Needed for" is the property "Uses". Unfortunately, Semantic MediaWiki does not support automatic validation of property characteristics, and therefore, it is advisable to formalize the characteristics and relations of semantic properties using domain ontology. Such ontology reflects the semantics and structure of the knowledge base of a semantized Wiki resource (as opposed to non-semantic Wiki-resources, due to various additional semantization possibilities this must be done for rather complex IPs to avoid ambiguous understanding of the content of the properties by different content developers) and can register inverse pairs of object properties.

In order to simplify the process of use of semantic properties that determine the meaning of relations between e-VUE articles we develop a special template "Relation" (Figure 2). This template is currently at the approval stage, and, in future, it can be extended by other semantic properties.

When creating ontologies, it is necessary to clearly define to which type of relations those relations established between terms belong. Misclassification can negatively affect the quality of ontologies.

To solve many applied problems, it is possible to use thesauruses instead of ontologies as a semantic model of knowledge. Until recently, the terms "ontology" and "thesaurus" were used as synonyms, but now in IT, the thesaurus is more often used to describe vocabulary in projection onto semantics, and ontology is used to model semantics and pragmatics in projection to the presentation language.

Usually, the thesaurus T is defined as a dictionary that contains lexical items (LI) with an indication of semantic relations between them.

A thesaurus (according to the third definition) can be considered as a special case of ontology, which is much easier to form and analyze, but it certainly does not provide the ability to present certain more complex knowledge structures.

Many authors consider the thesaurus as a hierarchical structure or a series of hierarchical structures that group groups of concepts with common characteristics that are expressed in terms of natural language. For most real-world domains, this is not the case, as the various relations used in the domain are incommensurable (e.g. "the article is written by the author", "the program is developed by the language").

More correctly, the thesaurus can be represented as a semantic network. In the nodes of such a network there are terms connected by relations from a limited set. It is also advisable to use oriented graphs and frames to present the thesaurus. Following many of the advantages of the semantic network, the frame network allows representing as vertices complex structures (frames) that have, in particular, unfilled fields (slots), which gives new possibilities when describing nested structures, switching between different applications.

Knowledge of these theoretical principles helps to more precisely define the mereological relations introduced into the ontology. Having defined the type of relation according to such a classification, it is possible to more clearly determine whether one or different relations can be used to define the relations between concepts.

When updating the semantic links between the thesaurus terms, you can use the knowledge of experts, as well as documents designed to record the domain knowledge structure (dictionaries, classifiers), and the knowledge itself that reflects the domain (abstracts, articles, monographs).

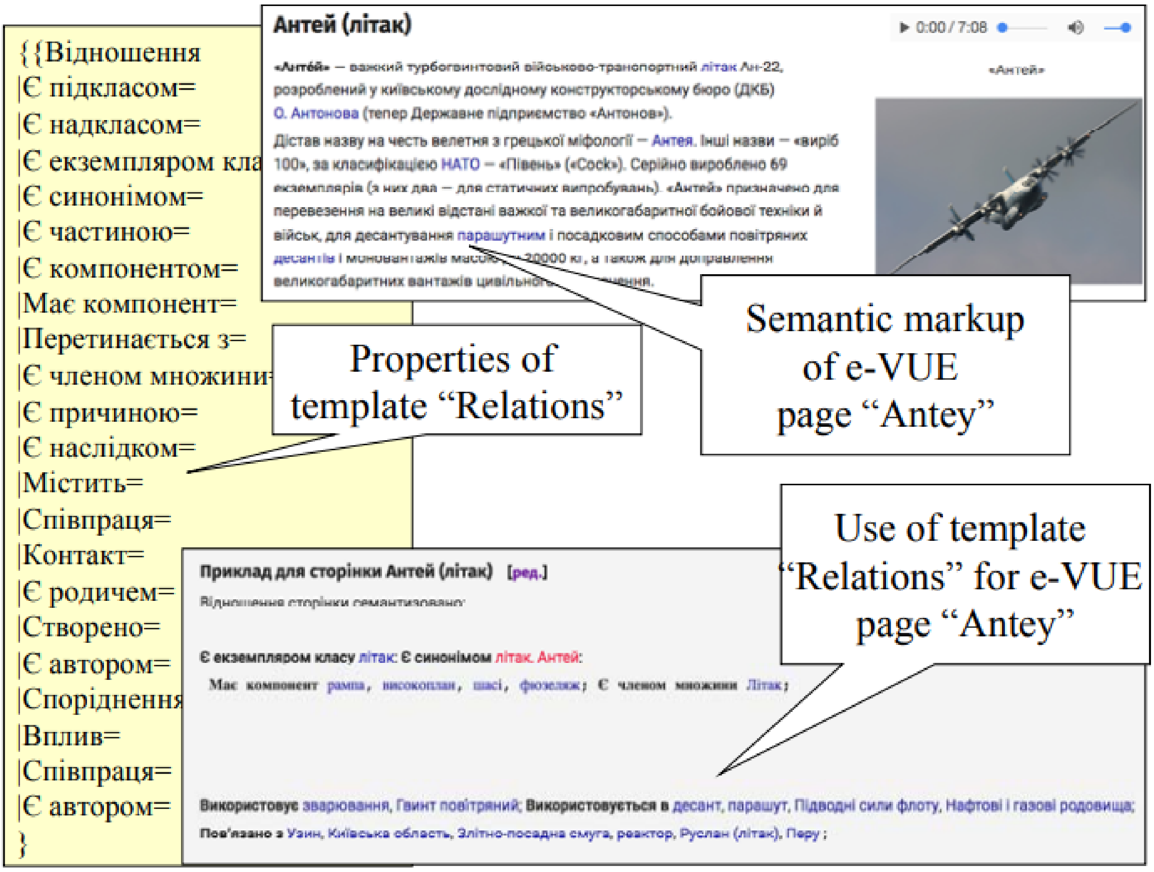


**Figure 2**: The "Relation" template and its use in e-VUE

## 7. Conclusions

The use of mereology as a theoretical basis for the definition of subtypes of "part-whole" relations between pages of semantics Wiki-resource makes it possible to define their meanings more clearly. It is important for encyclopedic IRs with complex structure of knowledge base that contains various domain-specific relations between concepts. If we can distinguish relations with different meanings for their automatic processing then we improve navigation in the resource and reduce the time needed by users to search for the necessary information.

With the help of a mereological approach, classification and differentiation of subtypes of widely used "part of" semantic relations becomes more understandable for editors who add semantic markup to e-VUE articles submitted to portal. Construction of specific relations within each subtype is determined by the content of this encyclopedic IR, but presence of classification criteria greatly simplifies the search for a desired relation.

Usage of the ontology represented by OWL language to formalize the characteristics of mereological relations ensures the unambiguity of their interpretation and reduces the probability of errors in their use.

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