ACADEMIC CONCEPTS ORGANIZATION IN SEMANTIC NETWORKS AND ITS REFLECTION IN SOME STRUCTURAL BLOCKS OF DEFINITIONS

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Abstract

In contemporary world scientific and professional knowledge expands at a very quick pace and new concepts must be properly defined. The existence of a definition aimed at a professional is considered to be a requirement for a technical term and its important distinguishing feature (see Lotte 1961, Superanskaya 1989, Leychik 2009, etc.), consequently, the study of the general principles of definition construction plays an important role in the systematization of terminological apparatus, the formation and development of knowledge expressed by various terminologies. However, definitions of technical terms sometimes appear to be incomplete, differ in structure and semantics for one and the same concept. This paper is devoted to the study of reflection of academic concepts systemic organization in certain structural blocks of their definitions. We claim that the definition can structurally be subdivided into prototypic blocks according to different pieces of information that outline the defining features of an academic concept. Our approach applies the principles of semantic network analysis to the terminology system modelling (see Malkovskiy 2012, Latu 2016, etc.). In such a terminological network the vertices are represented by technical terms while the arcs are semantic relations of certain types that link conceptually and systematically adjacent technical terms. In the course of analysis of the systemic organization of technical terms that appear in the considered definitions we defined the prototypic structural blocks based on the semantic relations between the adjacent technical terms. Thus, it sheds light on what technical terms are used in certain structural blocks to define other technical terms in the process of definition construction and what the choice of this specialized vocabulary units depends upon. The examples are mainly drawn from the actively developing terminologies of nanotechnology and space research as well as other terminologies when necessary. The corpora of technical terms and their definitions were extracted from specialized dictionaries and fragments of texts in specialized literature. It is also discussed that the choice of structural blocks that appear in definitions is to some extent predetermined by the category of the defined concept.

Keywords: academic concept, definition, technical term, semantic network, semantic relation, information

1. INTRODUCTION

The existence of a definition aimed at a professional is considered to be a requirement for a technical term (Superanskaya, 2003) because it outlines the borders of the expressed academic concept. However, definitions of technical terms sometimes appear to be incomplete, differ in structure and semantics for one

and the same concept. For this reason the study of the principles of definition construction is of great importance for lexicography, the development of knowledge in various fields and systematization of their terminologies.

Academic concepts of a certain field of science are systematically related, as well as the technical terms that express them within a terminology (Latu, 2015). Consequently, some technical terms are used to define other technical terms. These systemic relations can be visualized by means of a semantic network. In such a terminological semantic network the vertices are represented by technical terms while the arcs are semantic relations of certain types that link conceptually and systematically adjacent technical terms. M.G. Malkovskiy and S.Y. Solovyev (2012) used terminological networks for web glossaries development. In their terminological networks technical terms are linked up by two types of binary relations: "it is" (which corresponds to ISA and AKO semantic relations) and "refers to" that incorporates all the other types of semantic relations (Malkovskiy & Solovyev, 2003). Thus, a terminological network is a "natural superstructure based on a multitude of definitions of technical terms" (Malkovskiy & Solovyev, 2014). I. Atanasova and S. Nakov (2003) developed ArtsSemNet that is an electronic glossary of technical terms of fine art based on the network principles of their organization. The vertices a mainly linked by hyponymy (AKO – "a kind of") relations, however relations based on synonymy, homonymy, polysemy are also represented. The researchers remark that ArtsSemNet does not detect and display hyponyms that refer to one and the same generic term and treats meronyms as hyponyms. I.O. Serdceva (2006) constructs a terminological network of computer science technical terms that are also linked only by hyponymy semantic relations. These approaches to the construction of terminological networks are mostly based on hyponymy relations without paying attention to the specificity of other existing types and classification of vertices according to the categories of technical terms that we see as a disadvantage.

Technical terms of different categories may be linked by different types of semantic relations, among which are At ("attribute"), R ("result"), Loc ("location"), Ag ("agent"), PO ("part of") etc. (Latu, 2016). This research demonstrates how systemic organization of academic concepts is reflected in certain structural blocks of their definitions. A definition can structurally be subdivided into prototypic blocks according to different pieces of information that outline the defining features of an academic concept and the semantic relations between the adjacent technical terms. This sheds light on what technical terms are used in certain structural blocks to define other technical terms in the process of definition construction, and what the choice of this specialized vocabulary units depends upon.

2. TYPES OF INFORMATION BLOCKS IN DEFINITIONS

Generic affiliation information block represents the part of a technical term definition where the relationship with the concept that is or at least considered to be generic is mentioned, e.g. *"**heteroepitaxy** – {form of **epitaxy**}, in which the growing layer differs in chemical composition from the substrate material"* (Rusnano thesaurus). Generic affiliation is very important when a technical term is defined because it helps understand what the next level of abstraction is and depending on the category of the defined concept clarifies the nature, the type, the genus or the multiplicity it refers to. It may also give a hint of some possible common features that the described concept inherits and shares with the generic one. Moreover, generic affiliation information block may shed light on the position of the concept in the existing hierarchical classification system of knowledge in a particular field. This information block is very productive and is frequently used to define technical terms of various categories.

Very often a technical term definition starts with the generic affiliation, however it is just a general preference and a tendency to put this information block first as its position is not set and it may be potentially preceded by some other information blocks. It is worth noting that generic affiliation information block in a technical term definition may be represented by vocabulary units of different strata depending on the peculiarities of the defined concept and the type of definition. When the generic concept is expressed by another technical term of the field it is likely to appear in this information block of the definition. In this case the generic affiliation demonstrates the relationship of two adjacent technical terms within a system of knowledge within the same field (e.g. **smog** and **photochemical smog** in the field of ecology). In semantic networks such technical terms are linked by AKO ("a kind of") semantic relation that links the referent with its exact genus or ISA ("is a") semantic relation that links the referent with the multitude it refers to.

However for some technical terms there may be no generic concepts expressed by the technical terms that belong strictly to the terminology of this particular field of knowledge. In this case a multidisciplinary term may be applied instead or even words of general vocabulary that represent abstract and very general notions, such as «system», «object», etc. In a definition aimed at a specialist it is likely and more preferable that a technical term is used while in definitions aimed at non-specialists that appear in monolingual general-use dictionaries a word of general vocabulary may be used instead of the technical term to define the technical concept in "simple" words and make its understanding easier. Thus, generic affiliation may be expressed by

technical terms or words of general vocabulary. It is also important that the technical term used in this information block expressed the immediate generic concept that is on the next step of abstraction and not the concept a few levels up the classification tree that were skipped over.

Generic affiliation information block sometimes is omitted in the structure of a definition when the generic technical term is a constituent part of the defined multi-component technical term, i.e. technical term **ultrasonic coagulation** that is built upon the generic term **coagulation**. This information block may also be missing for some technical terms of certain categories such as Locus.

Constituents information block is another quite frequent part in the definitions of some technical terms. As it becomes quite clear, the name of it suggests that this block sheds light on the components, ingredients, constituent parts or units that are considered to enter in the composition of the defined entity and are significant in selecting it as a unique concept and opposing it to similar entities of the kind. This information block correlates with PO ("part of") sematic relation that link adjacent technical terms in semantic network one of which represents a meronym, being a part or a member of a whole expressed by another technical term, e.g. *"**heterostructure** – a structure {made up of **heterojunctions**}"* (Rennie, 2015). Part-whole relations are productive in semantic networks but constituents information block is introduced in the definition only if they are seen as essential and relevant in describing the specificity of the concept. PO semantic relation is common for various categories of academic concepts and is not limited to the technical terms that express mechanisms, instruments or natural objects/phenomena. This information block may be represented in the definitions of technical terms that express situations providing data about the entities that are involved into the event, processes being a part of other processes, locus being part of a larger area, e.g. *"**Corona** is {the outer part of the **Sun's atmosphere**} and is the region where prominences appear"* (Sreepat, 2013). It is worth noting that it may provide the information not only that the defined concept consists of something but also that it may be the part itself of a whole expressed by another technical term that correlates with the vector of PO relationship in the semantic network. Whether the link with the whole or the constituent parts of the defined entity if present, of course, is mentioned strongly depends on the concept itself and which of these two is considered to be a defining feature.

Location information block is also a common structural element of many definitions where the position of the defined entity in certain environment or in reference to other objects is one of the defining features, and according to which it is singled out as a unique concept. By localizing an entity to a particular place and specifying its location, the definition outlines the borders of the distribution, spreading, widening, occurrence or expansion of some entity expressed by an academic concept and reveals the scientific perception of it, e.g. *"**piezoelectric effect** – reversible electromechanical coupling of the electric polarisation and mechanical deformation {in **anisotropic dielectric media** with certain crystal structure and symmetry}"* (Rusnano thesaurus). This information block is based on a variety of semantic relations of positioning that adjacent technical terms of different categories can potentially establish in a semantic network. These encompass Loc semantic relation that shows that the defined entity is localized in, on or within the borders of a certain object or region, as well as Arnd ("around"), Intr ("inter", "between" two objects), Next to semantic relations, etc. Among the categories of the technical terms that they link are Locus, Natural object/phenomenon, man-made material, Process, Situation, Substance, Mechanism, etc., e.g. a process may occur on a specific surface, an object or phenomenon can be positioned inter some other objects. These peculiarities determine the vocabulary used in this part of the definition. Thus, a characteristic feature is certain prepositions of place. When the associated location is an academic concept, then the corresponding technical term is used, if not, then it is expressed by words of general vocabulary. The position of this information block in the definition is arbitrary as it may follow the generic affiliation block immediately or other parts.

Attributes information block reflects the properties and characteristics of an object or phenomenon such as color, size, form, intensity, etc. if they are considered to be defining features from the scientific point of view, e.g. *"**nanolayer** – {a **two-dimensional**} structure, layer or film on the surface of a solid or liquid {that has **nanoscale** thickness}"* (Rusnano thesaurus). Sometimes one or more of the defining features are also represented in the technical term itself, e.g. spiral galaxy, single-user multitask operating system. These features are also expressed in their definitions. It is worth noting that this information block can refer to the defined concept itself, but also be embedded into other information blocks and characterize other technical terms used in the definition providing more details about the concepts they express or adding specificity when necessary. For this reason the position of this block in the structure of definition is arbitrary and depends on the concept it provides information about. Words of general vocabulary are quite common as they express frequent attributes and properties, as well as numerals to show degree, size, percentage, etc. There are also technical terms of the category Characteristic linked to the defined concept by At semantic relation in the semantic network.

As for purpose information block, it primarily remains productive for the categories of concepts related to man-made objects of the environment, among which are Mechanism, Instrument, Material, etc., e.g.

*"**carrier** – an inert or semi-active material {used for stabilization of **particles** in an active catalytic phase on its surface}"* (Rusnano thesaurus). As they were created and produced to attain a certain aim, it is quite obvious and natural that this purpose may be one of the defining features and be mentioned in definition. This information block also may reveal the functions of the defined object.

Cause and effect information block reveals the relationship between the defined concept that is seen as a result, and something that caused it, e.g. *"**capsid** – protein shell of a virus {formed through self-assembly of one or more proteins into a geometrically ordered structure}"*; *"**gel** - – infusible and insoluble {product of **polycondensation** or **polymerisation**}*" (Rusnano thesaurus). The position of this block in the structure of the definition is not fixed as well. The technical terms used in this block are very often linked to it by means of R semantic relation. It is productive for different categories of academic concepts.

Subsumming concepts information block represents the part of a technical term definition where the subsumees are mentioned. The subsumes are the concepts at a lower level in a hierarchical classification for which the defined concept is considered to be generic. This information block reflects the same relationship between technical terms as generic affiliation information block does that is AKO semantic relation, but in this case it links the defined concept with its hyponyms. Apart from the generic affiliation block that is frequent in definitions, subsumming concepts information block is far less productive. If present, it is usually introduced as a final part of a definition, even rarer in the middle and never at the beginning. Moreover, if the defined technical term can refer only to one generic concept that is mentioned in generic affiliation block, it may have many hyponyms that form several classifications based on different characteristics. This may be one of the reasons why this information block is not so common because it may be problematic to mention all the hyponyms for which the defined technical term is generic. Thus, it is optional, however if the number of hyponyms is limited, it is still desirable to introduce the information about them in definitions as it also outlines the borders of the defined concept and points at its position in the academic knowledge organization.

Examples information block is the part of the definition where the typical representatives of a concept are illustrated, e.g. *"**outgassing** – the loss of gas from any solid, {such as the outgassing and recondensation of water vapour and other light molecules from spacecraft structures}"* (Ridpath, 2012). S. Hayakawa (1990) claims that definitions based on examples may tell a lot more about the concept than those that lack them. Moreover, this information block may refer not only to the defined concept but it can also be used to specify other concepts that are used in the definition. In this case it is embedded into the structure of another information block where the exemplified concept occurs, e.g. *"**ultracentrifuge** – a device used to separate particles of less than 100 nm size {(**colloids, subcellular particles, polysaccharides, synthetic polymers**, etc.)}, suspended or dissolved in the liquid"* (Rusnano thesaurus). Here it is based on ISA and AKO semantic relations between the specified concept and its examples. Similarly to subsuming concepts information block, it is rather unproductive and optional in the structure of a technical term definition. This information block is introduced as one of the final parts of a definition when refers to the defined concept, or follows the concept that is specified when embedded in another information block. Technically, round brackets may be applied to separate this information off.

Another information block that is not very frequent and productive is the opposition information block. This part of the definition represents facts about the concept that is in opposition to the defined one. Both are at one level of classification hierarchy and are hyponyms of the same generic concept. For example, **desorption** is defined as "*decreasing concentration of a component in the surface layer of a substance as compared to its concentration in each bulk phase. The opposite of **adsorption***" (Oura, 2010). It is quite obvious that many concepts have other concepts in opposition, however, they do not appear in their definitions that leads to conclusion that this information block is optional. Very often it occupies the final position and is introduced as a separate sentence after a period.

3. CONCLUSION

The results of the analysis prove that definitions of technical terms can be decomposed into parts that contain prototypic types of information, such as generic affiliation, purpose, location, etc. These information blocks very often correlate with the academic knowledge organization within the semantic network of a certain field and are based on one or several semantic relations that the defined technical term has with its adjacent technical terms. This also reveals what technical terms are used to define other technical terms. Information blocks may be of different productivity, and their order in the definition may vary. Information blocks that convey knowledge about subsumming concepts, concepts in opposition or examples are far not so frequent as compared to other information blocks and can be considered to be optional. Some information blocks may be embedded into the structure of other information blocks when necessary. The correlation between the types of information reflected in the definition and the category of academic concept represents a problem for further studies.

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