Published in the USA
European Journal of Technology and Design
Issued since 2013.
E-ISSN: 2310-3450
2023. 11(1): 21-26

DOI: 10.13187/ejtd.2023.1.21
https://ejtd.cherkasgu.press

Information Field Elements

Asya I. Todorova [a, *]

[a] Federal State Autonomous Educational Institution of Higher Education National Research Moscow State University of Civil Engineering (NRU MGSU), Moscow, Russian Federation

Abstract

The article examines the elements of the information field. The main features of the information field as an integral information model are described. The tasks of the information field are described. The information field contains patterns and relationships of the real world. The information field contains tacit knowledge. The main tasks of the information field are to obtain new knowledge and form a picture of the world. It is shown that the information field can be considered as a system. The system has elements. The elements of the information field are information units. Information units are used as elements of models regardless of the information field. This justifies their use as elements of the information field. The variety of application of information units is shown. Information units are used in linguistics, programming, education, decision-making, and system analysis. Information units serve as the basis for information modeling. Four groups of information units that exist in linguistics and in the information field are described. A set-theoretic approach for describing information units of different groups is shown. The article describes the features of information construction. Information units as elements of the information field contribute to cognition and the formation of a picture of the world.

Keywords: computer science, information models, information field, information units, information construction.

1. Introduction

The information field (Tsvetkov, 2014a; Tsvetkov, 2014b; Raev, 2021) is a phenomenon of modern science. The information field (IF) can be considered as a complex model that reflects real fields and individual objects of reality. In the information field, disparate objects of the real world appear in a single information environment. IF can be compared to a snapshot of reality. In reality, objects are independent of each other. But in a photograph, the images of the objects form a single picture. IF describes objects and processes. IF describes the content of processes in real fields.

IF is related to the Information Space (IS). IF describes the content of the real world, and IS solves the problems of coordinating the information field and sets the spatial orientation of the information field processes. Field and space complement each other. IF and IS reflect the superposition of real fields (Barmin et al., 2014). Together, they form a primary picture of the world (Tsvetkov, 2020). The information field unites disparate objects and fields of the real world into a single descriptive model. Models of individual objects appear in a single information environment. IF contains tacit knowledge. It contains a description of the patterns of the real world. The information field contains a description of information and spatial relationships.

* Corresponding author
E-mail addresses: asay.todorova@gmail.com (A.I. Todorova)

Real-world relationships between objects and fields can be complex. In the information field, complex relations are reduced and can be supplemented by information relations that do not exist in reality. This makes it possible to divide information relations in IF into two groups. The first group of information relations describes the relations of reality. The second group of information relations supplements the descriptions to explain the patterns and make the description more consistent with reality.

An important concept of the information field is the field function (Tsvetkov, 2014a). This characteristic expresses the content of the information field at a given point according to the selected criteria. In general, the model of the information field is more capacious and meaningful in comparison with a photograph of reality, a snapshot. The snapshot contains explicit information. IF contains tacit information and tacit knowledge.

The information field can be represented as an integral model (Tsvetkov et al., 2023), which contains information models: systems, situations, objects, process models, patterns models. This complex model contains simpler models and the relationships between them. Each of the simpler information models, in turn, contains parts, subsystems, and elements. The elements of these information models are information units as indivisible entities of the information field.

The information field is not created arbitrarily, but is based on a number of correspondences between the real world and IF. The simplest correspondence is the information correspondence between models and objects. Next is the semantic correspondence between the content of the models and the content of the objects. In addition to informational and semantic correspondence, there must be an ontological or conceptual correspondence. When displaying processes in the IF there must be a procedural correspondence between real and information processes.

The information field, as a composite model, must solve special problems. The first task of IF is to describe objects and phenomena in the real world. The second task of IF is to form information models as IF objects. The third task of IF is to create an information environment for research and modeling. The fourth task of the information field is to acquire knowledge. In order to extract knowledge in the information field, there must be opportunities for metamodeling (Tsvetkov et al., 2020). The main task of the information field is to form a picture of the world.

Many models have the property of being systematic and can be considered as complex systems. The information field is systematic and can be considered as a complex system. Any complex system contains elements. Such indivisible elements of the information field are information units (Ozhereleva, 2014). Therefore, in order to study the information field, it is necessary to consider its information units. The problem of analyzing the information field requires the study of its indivisible elements, that is, information units (Raev, 2020).

2. Discussion and results

Information Units as Modeling Elements.

Modern information modeling is intensively developing. The development of modeling is expressed in the emergence of new information models. These models include an information field model.

Applied informatics and applied geoinformatics solve many practical problems with the help of modeling. And informational modeling is of great importance in geoecology. Different types of monitoring are used to monitor the environment: geotechnical monitoring (Carri et al., 2021), geoinformation monitoring, space monitoring. Information modeling is used in all types of monitoring. There is a direction of onomasiological information modeling (Pavlov, 2019). This type of modeling builds models of objects and processes by breaking them down into small elements. This modeling results in the formation of information units.

Information units as elements of models are used in applied informatics and applied geoinformatics. Information units are used in linguistics and programming. Information units are used in information theory (Ivannikov i dr., 2007). In a detailed analysis of real-world phenomena, information units are used implicitly. In the theory of the information field, there is a concept of information units, which denote indivisible elements of the information field. Any analysis involves division. Andthe political division can be carried out to parts or to elements. Dividing to elements actually creates information units. There are a large number of works describing information units or their applications. However, until now, no attempt has been made to write a general theory of information units. The first feature of information units is that they form specialized units groups

when used in different technologies. For example, there are linguistic information units (Smith, 2006). There are communication information units (Fassier, Azoulay, 2010), and there are logical information units (Tajima et al., 1999), there are lexical information units (Almela, Sánchez, 2007), there are representational information units. There are paralinguistic information units (Tsvetkov, 2013). Thus, information units are used in the construction of models, in the construction of models, and in modeling.

Information Units and Set Theory.

The theory of information units uses the theory of information and the theory of information modeling. There are different approaches to the description of information units. The description of information units can be done using set theory.

Information units (IUs) are used in two directions when building models: decomposition and composition. Information units are used when dividing modeling objects or systems into elements. IUs are used in the construction of models and objects. The first direction in technology can be compared to disassembly. The second direction can be compared to assembly. There are different groups of information units. From the standpoint of set theory, units are elements of sets. In the field of linguistics, there are four groups of information units.

The first group includes symbols or structural information units $x_0 \in$ANL. The set of ANLs corresponds to the natural language alphabet.

The second group includes words or semantic (Guo, et al., 2019; Tsvetkov, 2014c) information units x_1Lex$\in$. The Lex set corresponds to the vocabulary of a given language. Words have a semantic environment that explains the meaning of the word.

The third group includes sentences as collections of related words. Sentences are predicative information units $x_2 \in$(Lex, Rel). The set (Lex, Rel) corresponds to the vocabulary of a given language and the set of valid relationships between words, including syntactics.

The fourth group includes related sentences or phrases. Phrases are phraseological information units $x_3 \in$(Lex, Rel, Con). A set (Lex, Rel, Con) corresponds to the vocabulary of a given language, a set of valid relationships between words, a set of contextual expressions Con of a given language. In natural language, Con is expressed by pronouns, i.e. noun substitutes. There are relationships between units.

$x_0 \in x_1$, Sint1 (1)

$x_1 \in x_2$, Sint2 (2)

$x_2 \in x_3$, Sint3 (3)

In expression (1), Sint 1 is the syntax for forming words from symbols. In expression (2), Sint 2 is the syntax for forming sentences from words. In expression (3), Sint3 is the syntax for forming phrases from sentences.

In the field of programming, the following groups of information units are distinguished.

Symbols or structural information units $y_0 \in$APL. The set of APLs corresponds to the alphabet of a programming language.

Operators or semantic information units y 1 $\in$Lex1. The set Lex1 corresponds to the vocabulary of the operators of a given language.

Operands or semantic information units y 2 Lex 2. The set$\in$ of Lex2 corresponds to the vocabulary of the operands of a given language

Sentences or predicative information units $y_3 \in$ (Lex 1, Lex 2, Rel, Sint). The set (Lex 1, Lex2, Rel, Sint) corresponds to the allowable stock of clauses, according to the permissible relations Rel between and the valid syntax Sint.

In the field of system analysis, the following groups of information units are distinguished.

Elements of the system or structural information units $z_0 \in$ A Sys. The set ASys corresponds to the alphabet of the elements of the system.

Sets of elements or composite information units z 1 $\in$Lex1. The set of Lex1 corresponds to the vocabulary of the constituent elements of the system.

Process Elements or Process Information Units $z_2 \in$APSys. The set of APSys corresponds to the alphabet of elementary processes in a given system

Blocks or predicative information units of the z_3 system $\in$(ASys, APSys, Lex1, Rel, Sint). The set corresponds to the allowable stock of elements and blocks, according to the valid Rel

relations between the elements of the system and the valid Sint syntax for constructing the structure of the system.

In the field of systems analysis, there are two qualitative types of information units: structural and processual. In linguistics, there is only one type of elementary information unit.

In the field of information analysis or information field theory, the following groups of information units are distinguished.

Elements of the information field or symbolic information units $w_0 \in$AF. The set of AFs corresponds to the alphabet of the elements of the field.

Composite Information Units or Information Models w 1 Lex 1. The set of ∈Lex 1 corresponds to the vocabulary of the constituent elements of the field.

Process Elements or Process Information Units w_2 APr. ∈The set APr corresponds to the alphabet of the elementary processes of the field.

Blocks or enlarged information models $w_3 \in$(AF, APr, Lex1, Rel, Sint). The set corresponds to the allowable stock of elements and blocks, according to the valid Rel relations between the elements of the system and the valid Sint syntax of building the model.

On the basis of generalization, the following general groups of information units can be distinguished.

Elements or symbolic information units $iu_0 \in$AU. The set of AUs corresponds to the alphabet of symbolic information units or the alphabet of the formal language of description.

Compound Information Units or Information Words iu 1 Lex 1. ∈ Lex1 corresponds to the vocabulary of information words.

Process Elements or Process Information Units iu_2 APr. ∈The set APr corresponds to the alphabet of elementary processes.

Blocks or enlarged information words $iu \in_3$ (AF, APr, Lex1, Rel, Sint). The set corresponds to the allowable stock of elements and blocks , according to the valid Rel relations between the elements of the system and the valid Sint syntax of building the model.

Construction of IE in the information field.

Information units in IF are created by dividing the original set or by composing simple IUs. Division in the information field is performed from top to bottom, that is, from larger objects to smaller ones. Start dividing using categories. Different mathematical methods are used for this. The simplest method is to Method of separating hyperplane in parameter space. Then, the similarity/difference grouping is used. This method is implemented through cluster analysis. Within the cluster, division is performed using dichotomous analysis. Then the units are checked for dependency and independence. For this purpose, correlative (Tsvetkov, 2012) analysis and oppositional analysis (Luhar et al, 2014; Tsvetkov, 2014d) are used. The procedures for dividing the information set use information models.

As a result of dividing the initial information set, sets of division elements (ed) are obtained, which are checked for proportionality to information units and models.

Simple information units oiu are independent of and unrelated to other information units.

$(oiu_i=ed_i) \wedge (oiu_j=ed_j)=0; i \neq j$ (4)

Compound information units ciu are a linear combination of simple information units.

$ciu=A1\ oiu_1 + A2\ oiu_2 + Ai\ oiu_i$ (5)

IM blocks or models are a functional combination of simple and compound information units.

$IM=F1(oiu_i) + F2\ (ciu_k) + F3\ (oiu_L, ciu_p)$ (6)

Design in the information field.

There is a difference in fission and construction models. When dividing, models are built according to the principle of "what exists". When constructing, models are built according to the principle of "what should be". Design in the information field is carried out "from the bottom up", that is, from small objects to larger ones. They start constructing using simple information units. The construction of information models is carried out according to the required functional features of the models. The use of information units entails the standardization of construction and the standardization of information exchange. Information units as standardized objects are stored in databases. It is necessary to note the specifics of information design in geoinformatics. This specificity is manifested in the "big" and "small"

In the "big" context, the specificity of geoinformatics lies in the integration of models and technologies by geoinformatics. In geoinformatics, groups of information units are used that are used in other sciences.

In the "small" context, the specificity of geoinformatics lies in the qualitative diversity of information units. Geoinformatics uses geodata (Zuo, 2020), which contains three types of data: place, time, and topic. Three types of data define three qualitative groups of information units. Another specificity of geodata is related to the processing of video information. Data models in GIS and geoinformatics have two forms of representation: visual and digital. Geoinformatics and GIS allow the processing of information in digital and visual form. For the visual form of models, universal information units are used: pixels, tiles, and patterns. For the "place" data group, information units are used in the form of coordinates of points and intervals.

The detail of information units and their semantics make it possible to extract knowledge. As a result of the use of information units and modeling, digital maps and digital models are created.

3. Conclusion

Information units are universal elements of analysis in the study of the world around us. IUs are the natural language equivalent of the alphabet. IUs are a means of describing objects, and this description provides comparability. This description extends to objects and to the general picture of the world. Information units are elements of many processes. IU is used for different purposes. IU is used as a tool to ensure the connection of the categories "information", "information resources", "knowledge". Information units are used as elements of semiotics. Semiotic signs are units of information. IUs are used as elements of application systems. IUs are used as elements of decision-making processes and as elements of decision support processes. IUs are widely used in education. In education, IUs act as didactic units. Despite the widespread use of information units, they are not always called information units. This hinders the generalization of the experience of their application and the development of the theory of information units. The study of information units is promising for the further development of computer science and the construction of a picture of the world. General conclusion: information units are elements of models and elements of the information field. IUs contribute to the knowledge of the world around us and to build a picture of the world.

References

Almela, Sánchez, 2007 – *Almela, M., Sánchez, A.* (2007). Words as “lexical units” in learning/teaching vocabulary. *International Journal of English Studies*. *7*(2): 21-40.

Barmin et al., 2014 – *Barmin, I.V., Kulagin, V.P., Savinykh, V.P., Tsvetkov, V.Ya.* (2014). Near-Earth space as an object of global monitoring. *Solar System Research*. 48: 531-535.

Carri et al., 2021 – *Carri, A., Valletta, A., Cavalca, E., Savi, R., Segalini, A.* (2021). Advantages of IoT-based geotechnical monitoring systems integrating automatic procedures for data acquisition and elaboration. *Sensors*. 21(6): 2249.

Fassier, Azoulay, 2010 – *Fassier, T., Azoulay, E.* (2010). Conflicts and communication gaps in the intensive care unit. *Current opinion in critical care*. 16(6): 654-665.

Guo et al., 2019 – *Guo, L., Liu, J., Tang, J., Li, J., Luo, W., Lu, H.* (2019, October). Aligning linguistic words and visual semantic units for image captioning. In *Proceedings of the 27th ACM international conference on multimedia*. Pp. 765-773.

Ivannikov i dr., 2007 – *Ivannikov, A.D., Tihonov, A.N., Tsvetkov, V.Ya.* (2007). Osnovy teorii informacii [Fundamentals of information theory]. M.: MAKS Press, 356 p. [in Russian]

Luhar et al, 2014 – *Luhar, M., Sharma, A. S., McKeon, B. J.* (2014). Opposition control within the resolvent analysis framework. *Journal of Fluid Mechanics*. 749: 597-626.

Ozhereleva, 2014 – *Ozhereleva, T.A.* (2014). A Systematics for Information Units. *European Researcher*. 11-1: 1894-1900.

Pavlov, 2019 – *Pavlov, A.I.* (2019). Onomasiologicheskoe informacionnoe modelirovanie [Onomasiological information modeling]. *Slavyanskij forum*. (3): 45-55. [in Russian]

Raev, 2020 – *Raev, V.K.* (2022). Informacionnye edinicy v informacionnom pole [Information units in the information field]. *Slavyanskij forum*. 1(35): 104-114. [in Russian]

Raev, 2021 – *Raev, V.K.* (2021). Informacionnoe prostranstvo i informacionnoe pole [Information space and information field]. *Slavyanskij forum*. 4(34): 87-96. [in Russian]

Smith, 2006 – *Smith, A.* (2006). Speech motor development: Integrating muscles, movements, and linguistic units. *Journal of communication disorders*. 39(5): 331-349.

Tajima et al., 1999 – *Tajima, K., Hatano, K., Matsukura, T., Sano, R., Tanaka, K.* (1999, August). Discovery and Retrieval of Logical Information Units in Web. In *WOWS*. Pp. 13-23.

Tsvetkov et al., 2020 – *Tsvetkov, V.Ya., Shaitura, S.V., Minitaeva, A.M., Feoktistova, V.M., Kozhaev, Yu.P., Belyu, L.P.* (2020). Metamodelling in the information field. *Amazonia Investiga*. 9(25): 395-402.

Tsvetkov et al., 2023 – *Tsvetkov, V.Ya, Romanchenko, A., Tkachenko, D., Blagirev, M.* (2023, April). The Information Field as an Integral Model. *Computer Science On-line Conference* (pp. 174-183). Cham: Springer International Publishing.

Tsvetkov, 2012 – *Tsvetkov, V.Ya.* (2012). Framework of Correlative Analysis. *European researcher*. 6-1 (23): 839-844.

Tsvetkov, 2013 – *Tsvetkov, V.Ya.* (2013). Paralingvisticheskie informacionnye edinicy v obrazovanii [Paralinguistic information units in education]. *Perspektivy nauki i obrazovaniya*. 4(4): 30-38. [in Russian]

Tsvetkov, 2014a – *Tsvetkov, V.Y.* (2014). Information field. *Life Science Journal*. 11(5): 551-554.

Tsvetkov, 2014b – *Tsvetkov, V.Ya.* (2014). Information space, information field, information environment. *European researcher*. 8-1: 1416-1422.

Tsvetkov, 2014c – *Tsvetkov, V.Y.* (2014). The Semantic environment of information units. *European researcher*. (6-1): 1059-1065.

Tsvetkov, 2014d – *Tsvetkov, V.Ya.* (2014). Opposition information analysis. *European Journal of Technology and Design*. 4(6): 189-196.

Tsvetkov, 2020 – *Tsvetkov, V.Ya.* (2020). Formation of the world picture. *European Journal of Technology and Design*. (8-1): 33-37.

Zuo, 2020 – *Zuo, R.* (2020). Geodata science-based mineral prospectivity mapping: A review. *Natural Resources Research*. 29: 3415-3424.