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Information as Ontological Category of Nature and Its Diversity

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The limits of modern science will certainly be marked by the limits of human understanding inherentic human nature.
René Dubos

Abstract:

Purpose: *The main purpose of the article is to highlight diversity and ontology of information and next its the role and impact on modern management of natural processes of knowledge about their connections with information.*
Design/Methodology/Approach: *The authors accepted the thesis that complex processes which contemporary management encounters should be solved with the use of complex formal tools.This is not possible without the proper use of categories of information appropriate to a given problem.*
Practical Implications: *Thanks to the new and formal paradigms of modern science we are able to penetrate deeper into the nature of the real processes (economic, social, banking and even into our- human mind, it is in our information thinking) and their complexity (structure). All this is possible thanks to the knowledge gained through the information received about it. Even physicists are increasingly inclined to consider information as a state of matter. And this is where its practical role comes from.*
Originality/value: *The originality of the content of the article lies in the combination of theoretical(especially formal approaches) concept of information related to the research on soft structures dealt with in the humanities.*

Keywords: *Ontology of information, topological nature of information, role the category of information, practical role of information.*

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1. Introduction

The problems discussed so far related to diversity and limitations through degrees of freedom, vectors and other structures for the examined objects and processes consisted in acquiring information (knowledge) about the analysed reality. Such information, for example, is a combination of the concept of a vector with a simple sample taken from the population under study. Below, an outline of answering about the nature of this very important concept for people and science will be presented.

Paradoxically, information is one of the most complicated concepts, also for modern science. It still remains a mysterious category of Nature. It is about understanding and scientifically defining it. Through information we understand everything, it is the most important transfer of seeing and understanding by people the diversity of nature and thus its limitations and the limitations of human thinking. So through the information obtained, the uncertainty of the World is minimized. The human horizon of learning the secrets of reality is expanding.[4]

2. Information and Meaning (Share of Information Measures in Creating Knowledge and the World of Values)

So far, the considerations boil down in a sense to the presentation of processes in the aspect of information, and then to the methods, and preferably the methodology of its presentation – measuring and finally expressing information in an objective way, i.e. adequate to the content. This is the ideal (Platonic) idea. But practice, as a rule, is always different, because it is related to the matter of reality. The motto presented at the beginning of the chapter actually solves this problem, but these are only the words of one scholar (Dubos, 1973).

Measures of information contribute to the creation of human knowledge and values Human knowledge and values are created through understanding – the psyche. They are transmitted through information, i.e. through signs of natural language and thinking, but then they are eventually redefined into the concepts of science and value systems.

Before discussing the problem of the participation of information measures in the creation of knowledge and human values, it should be noted that, in general, human activities come down to only three dimensions that are related to the concept of information.

They are:

- Energy dimension – thermodynamic carrier of information (Brillouin, 1969).

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[4]*If information is obtained through the study of a process, it limits its diversity (indeterminacy) and it is never the case that information will increase diversity (Ashby 1963, pp. 191-193).*

- Selective dimension – the amount of information – a measure of ordering a given system, measured by entropy (Shannon and Weaver, 1949).
- Semantic dimension – containing the content of the message (Universals of Language, 2nd ed., 1966).[5]

3. Information Semantics

The ambiguity of the term information does not only apply to its three dimensions mentioned above. In general, the dimension of the concept of information, i.e., its ambiguity of occurrence in the world, is still not fully understood. The term ambiguity should rather be understood as semantic subtleties related to the ways in which the word information is used. It would be worth considering what way of understanding this phrase could be adopted by science (Schroeder, 2015).

At the same time, it is an interesting semantic problem for researchers. There is a problem of content measures of information. René Thom – the creator of the mathematical theory of catastrophes – proposed a solution to this problem within his idea of archetypal morphologies related to elementary catastrophes, i.e., the so-called topological types of (also elementary) processes taking place around us (Thom, 1972; 1973a; 1973b).[6] The starting point of his thinking was the structural (operational) analysis of the term information, used in its colloquial (semantic) sense. So, what is the colloquial understanding of this concept?

The fundamental feature of information is all its exchange between parties (objects), i.e. the transmission of messages between these objects, different in terms of their complexity, but only of a physical nature (physical morphologies), biological

[5] *It is assumed that the energy aspect has little to do with semantic, which means that the amount of energy needed to carry a message does not determine its semantic content. However, in some clinical studies, this dimension can be used as a measure of the strength of semantic relationships within a field or between semantic fields of individual words of a language. It is also believed that it is one of the objective methods of examining the strength of connections in their semantic fields (Łuria 1975). How, however, in an operational and methodological way these relationships should be expressed in the language of thermodynamics, is still an open problem for science, but both cognitively, philosophically, and from the operational point of view, this problem is an interesting and important scientific discourse. We will now discuss the relationship between message content and uncertainty (information entropy). From the formal point of view, this relation is not simple and insignificant, although its analytical representation, especially for the case of a discrete random variable X, is clear and understandable, because it is expressed in the following form:*

$$H(X) = -k\sum_{i=1}^{n} p_i \cdot \log p_i$$

where the factor k is the modulus of the transition from one base of the logarithm to another.

[6] *The general theory of catastrophes has not yet emerged, but the theory of complexity has been born in mathematics (Peters 1997, p. 10).*

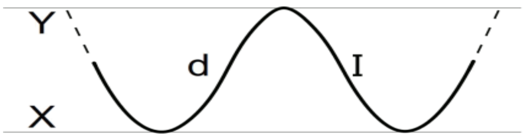
(biological morphologies), or semantic (morphologies with a complexity that includes language and thinking). And it is these three dimensions of information that constitute its ontology.

Considering a typical situation in the process of language communication, a typical situation is in the process of language communication, which is the central object of broadly understood communication – it is the one in which there is a human being. Given a sender of information *Y* and a receiver *X*, the receiver asks the sender – asks question *d*– for information *I*.

After receiving the answer to the question, the recipient *X* has some information – satisfactory or not. As a result, the process can be repeated (generated many times). This is the essence of communication. The general scheme of the described procedure includes two relatively independent entities, which in linguistic terminology are called *actants*– the sender of information *Y* and its recipient *X*.

Thus, a general scheme of interactions between *X* and *Y* can be drawn up. The edges of the graph (parallel lines) represent the entities, and the vertices (broken lines) the emission or reception of a message by a given entity (*actant*– as defined by L. Tesnière 1959) is shown in Figure 2.

Figure 2. *Topological form of the information process*



Source: *Thom R., Topologieetlinguistique, Essays on topology and related topics, Memoires dedies à George de Rham, Springer Verlag, Berlin 1970, pp. 226-248.*

Considering the degree of complexity of graphs related to archetypal morphologies (Thom 1970; Kołwzan 1983, pp. 295-296), it should be noted that the presented graph (Figure 2) is characterized by a relatively high topological complexity, i.e. the spatial dimension of the information process. Each *actant* is an independent element here. Therefore, it requires additional content interpretation.

ActantI is the focus of the proper meaning of the term information. The rest of the graph is a kind of environment, the existence of which is implicit in this concept. As R.C. Schank, the message generates subsequent actions, i.e. in some way its environment, and moreover, it also results from many communicative (linguistic) situations that occurred before its implementation.

And so it can be said that each message together with others creates a semantic network – a semantic field with a topologically complex structure (Shank, Goldman, Reiger, and Riesebeck 1975). Thus, the actual kernel of the environment is the transmission of message *I* from *Y* to *X*. This complexity explains the semantic instability of the word information. The process is so complex that human beings in their pragmatic actions limit themselves to only a part of the chart structure $\varsigma = < X, Y, d, I >$. He focuses his attention on the transmission core. This is a local action, and therefore limited to three elements of the communication process, to:

$$Y \xrightarrow{I} X$$

Depending on which part of this environment has been omitted, one can talk about different meanings of the term information. And perhaps this is the secret of our second system of signals – its structure (Kolmogorov 1988, pp. 43-68) and also in what René Dubos preached, i.e., in our natural limitation of knowing the world, understanding its behaviour, when such a natural limitation occurs.[7]

4. Diversity of the Nature of Information in the Dimension of its Transmission

The concept of a set, understood as a certain variety, plays an important role in the field of communication (especially information is based on a set, but related elements, i.e., on some order). A single act of communication – transmitting information or receiving a message – requires the existence of a set of possibilities, i.e., the environment associated with the message. The information provided is not only an internal property of the content of an individual message.

When thinking about the communication process, one should think not about its single element, but about the whole set of possibilities. A single message represents an event from a certain distribution, but with respect to the transmission of that message. And that is why it is the linguistic environment that generates certain acts of communication.

Thus, if we call such acts events, they are not independent of each other (as opposed to a set of elementary events in relation to the calculus of probability). They create some structure, and the dependence in the set of its elements is a limitation of diversity. In addition, communication also takes place in a certain social

[7]*Mathematical example: (Thom R., L'information-un protée de la sémantique, Colloquium Unesco, Venice 1973a). If you put a pencil on its tip at point O on the plane, you can say that this position encodes a circle K with radius r equal to the length of the pencil and centre O, i.e. a geometric figure K(O,r). Each point of the circle corresponds to one of the final stable situations that may arise from this unstable initial situation.*
Linguistic example: Each formal grammar G defines a set of words that make up the formal language of a given grammar (this grammar generates this language L(G)). However, in a particular case, the axiom S of grammar G generates a single word x belonging to language L(G). This word describes a concrete real or abstract situation (morphology). There is a limitation of diversity – the choice of one situation from a set of possibilities.

environment, but in the framework of human speech, it is primarily governed by the structure of the natural language.[8] Each structure is a constraint of diversity.

Diversity constraint, as we already know, can be weak or very strong. It can manifest itself in relation to the ordering (distribution) of objects according to certain established criteria. In the structural linguistics theory, this is called distribution (Gołąb *et al.*, 1968, pp. 144-145), and the structure of the distribution of language elements is reflected at its various levels, but especially in the syntax of the language.

Thus, the limitation of the variety of messages results from the very organization of the language, i.e., its structure. In the works of many linguists, it is proved that language is an object with a very complex structure, multi-layered (language levels) and multi-dimensional at the same time (relationships within one language level), because language represents the diversity of the human environment, which is multi-level and at the same time multi-dimensional and multi-criteria.

Tadeusz Milewski (1965, p. 15) wrote that: *"...language is a permanent, social and abstract creation..."*. And in this expression its multi-layered, multi-level and multi-criterion nature within human speech is closed. The above-mentioned main components of the language generate a variety of syntactic and content messages of the language through thinking, because the content includes human thinking.

This means that each linguistic message has its own motivation for use. Motivation is a dependence on the environment (context or situation) in which such a message was generated to communicate something about the environment. That is why René Thom (1972; 1973a; 1973b) advocated the view that language and its environment are in a state of resonance. The Polish linguist L. Zabrocki gave a different definition of the structure of language to Milewski's definition. He defined language as a system of transponal systems (Zabrocki 1961; Kołwzan 1983), i.e., having a close relationship with reality with the above-mentioned complex dynamic structure.

The approaches to understanding the functions of language that have been cited so far are very similar to each other, and at the same time they are formulated in a variety of content and expressed in a different way in the syntactical form. This proves the variety of means of description (representation) of the same analysed problems (sometimes semantically or even ontologically identical).

One such measure is the social dimension of speech and language. How and whether this problem should be discussed will be discussed later in this paper. At the end of the text devoted to information, however, it is essential to mention a certain variety

[8]*It is as if another object is at play here – a structure that governs linguistic communication and language at the same time. This object (structure) is our human thinking. This process of the mind along with the speech will be given attention later in the article.*

that disturbs the message transmission, and generally speaking the desired content information sent at the channel input, which is information noise.

5. Noise as an Ontological Category of the Diversity (Nature) of Information

From the point of view of the information theory, with regard to the transfer of information (messages) through the information channel, the nature of the channel implies that the input of the information transfer channel is basically divided into two or more components. The channel is available for transmitting many forms of information simultaneously. And only from the point of view of the sender and recipient of information, these components are recognized.

Recognized, i.e., their participation in the message is assessed, i.e., to what extent these components interfere with each other (Information theory for some information channels can express these relationships quantitatively (Shannon and Weaver 1949; Ashby, 1963, pp. 266-267; Kołwzan *et al.*, 2021, pp. 602-603).

Two messages were sent over one and the same channel simultaneously and were reproduced separately on its output. Sometimes, however, as Ashby *et al.* (1963, p. 264), these two inputs cannot be accurately reconstructed from the output. Because if attention is focused on only one of the components of the input as a source of diversity, and the other component is treated as an inevitable disturbance, then in the Theory of Information in this case we speak of a message disturbed by noise.

At this point in the discourse on the distortion of messages by the noise factor, sometimes caused by the influence of a random factor, it should be emphasized that noise in its essence is indistinguishable from any other form of diversity occurring in the world of R^3. It constitutes its own diversity, its own dimension of the topological space of information. But it is generally the case that the behaviour of any system depends on the variety of noise categories. After all, there are systems and processes in Nature that are independent of other processes in their environment, and therefore also of noise.

Thus, distinguishing noise from a message, one variety from another, is possible only when there is a recipient – an addressee, and in an even more general dimension, an observer who can decide which information is important to him.[9]

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[9]*Technical example from the area of electronics: A conversation and some additional phenomena caused by irregular emission of the cathode are simultaneously transmitted over the wire. For someone who wants to hear the conversation, the changes at the cathode are noise – an interruption to the conversation. Now, for the engineer trying to quantify what is happening at the cathode, the noise is talking. Thus, noise can be defined in relation to the addressee (receiver of information), who needs to know what information of the message he intends to omit (Ashby 1963, p. 264).*

In science, as commonly, noise is understood as it is defined in electronics. This is due to the fact that the concept and algorithm for measuring the amount of noise with a mathematical measure was originally developed on the grounds of electronics and technology.

Specialists in other fields of science may, however, understand and use the concept of noise in the sense related to the content of the channel and messages (content) related to their fields, i.e. understand it differently than electronics, more generally. The disturbances, noises and distortions of processes are simply of a general, ontological nature.

For example, in biology, the source of noise will be another macroscopic (microscopic) biological system, from which the tested system cannot be completely isolated.

In chemistry, hydrogen and oxygen combined in a chemical reaction (in the same channel) give water, the basis of life; but when mixed improperly, they generate an explosive mixture.

On the battlefield, where two fighting parties – armies, on the same terrain (canal). they want to defeat – destroy the enemy, they need information - recognition of the other side, its military capabilities. The lack of this information constitutes noise in the sense of diversity.

In the area of language communication, noise occurs as numerous speech disorders in the transmission of messages and language content. They are caused by two basic categories of causes:

a) speech disorders – aphasia (genetic and educational reasons) and
b) disorders resulting from general social causes: deficiencies in education, upbringing and other reasons.

But the richness of the means of language (speech structure) lies in the fact that, despite the noise, distorted messages – their content, are understood. This allows the so-called redundancy – linguistic redundancy. What's more, it is this redundancy, also as a wealth of the means of communication, through culture, literature, art, economy, that protects a given language against excessive contamination – disorder, contamination of the language with words and morphology of foreign languages and foreign negative influences.[10]

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[10]*In linguistics, the term contamination is classically understood as a morphological phenomenon, which consists in the crossing of two linguistic forms close to each other in phonetic and semantic terms, resulting in a new form (Gołąb, Heinz, Polański 1968, p. 299). Contamination for the language brings positive phenomena as well as negative ones. However, there are channels for this phenomenon in other areas where the concept plays a*

The last problem within the discussed issue that will be considered is the question: why did Nature foresee and equip man with the redundancy of language? This was done to facilitate communication in noise conditions. Information theory can calculate redundancy for some messages. Which boils down to the Shannon-Fano theorem about the optimal, in terms of channel capacity and speed of information transfer through a given channel, information coding (Jaglom and Jaglom 1963, p. 185).

Potentially infinitely many examples can be generated to illustrate the issue. And because the presented considerations must have a sensible and practical conclusion, i.e., provide a logical conclusion regarding the concept of noise, so in order to formulate it, the issue of encoding and decoding information must be included in the considerations.

Because if two (or more) messages (circuits) could be reproduced simultaneously and accurately by decoding the channel output, the concept of noise (its category) would not have much meaning for the message. Therefore, the concept of noise, especially when messages (one desirable, the other undesirable) interact with each other and destroy each other to some extent, causing the encoding to become incompletely reversible (the second information is not fully recognized – decoded (Ashby, 1963, p. 264)).

At the same time, it also happens that decoding information is impossible (this case is omitted), or it results from the loss of some information – not necessarily due to noise, unless such an event as the loss of part of the information is recognized as noise.

The issue of encoding and decoding, where randomness is involved, will be presented on the example of abstract data (example 1), which contain formal operationalization, i.e. an explanation of what information loss is and what cognitive effects it generates in relation to encoding and decoding information.

Example 1. 50 stages of the behaviour of an object with two states A and B were traced. This behaviour is presented in the following sequence:

$$(*)\ \begin{cases} A_0 | \ B\ A\ B\ B\ B\ A\ B\ \bar{A}\ \bar{A}\ B\ A\ B\ A\ B\ A\ B\ B\ B\ B\ A\ B\ \bar{A}\ \bar{A}\ B \\ A\ B\ B\ \bar{A}\ \bar{A}\ B\ A\ B\ B\ A\ B\ \bar{A}\ \bar{A}\ \bar{A}\ B\ A\ B\ B\ \bar{A}\ \bar{A}\ B\ B\ A\ B\ B\ A \end{cases}$$

The sequence contains transitions from one state to another. Matrix 1 presents four existing possibilities of transition from one state to another.

negative role. This is, for example, an area related to environmental protection – its pollution. They cause changes in our environment, but are they always positive, but generally they are changes.

Matrix 1. *Options for changing the states of the examined objects*

→	*A*	*B*	∑
A	6	17	23
B	17	10	27
∑	23	27	50

Source: *Own study.*

In the presented sequence, the transitions into itself are marked with dashes above state A. Their number is 6.

By dividing the element of a given row and a given column by the sum of the row elements from the matrix, based on the recorded transition protocol, a table was obtained representing the empirical frequency of transitions from one state to another (Matrix 2).

Matrix 2. *State transition matrix*

→	*A*	*B*	∑
A	0,26	0,74	1,00
B	0,63	0,37	1,00
–	–	–	–

Source: *Own study.*

The conclusion was that having a representative behaviour of the tested object of the nature of the Markov process at your disposal, you can build a transition matrix on the basis of its behaviour, as shown in the presented example.

It should be remembered, however, that because the presented example contains too few observations, it is therefore only illustrative for the problem under consideration.

Logic deals with the premises (as it were, the causes) of the considered processes. On the basis of premises, it can generate possible effects (sequences of causes), which are called conclusions. Conversely, on the basis of knowledge of the conclusion, it is able, in some cases, to indicate, generally speaking, what was the cause (premises) of its occurrence.

The above relationship will be used to analyse a problem important for practice: If the string of Matrix 1 and Matrix 2 from the above example are treated as mutual encodings (transformations), then in which direction of encoding information is lost, i.e. it is impossible to decode – to restore information?

One of the coding elements is lost, one of the coding objects. Interpreting the problem formulated above from the logical point of view, one of the elements of a simple or inverse implication. This means that information is lost from string (protocol) to Matrix!

This is due to the fact that the sequence of states, obtained from simulations based on the Monte Carlo method, or observed, gives the only empirical matrix, which in turn can only give a set of possible, similar sequences – Markov chains.

In other words, a lost matrix can be reconstructed from the string, but a misplaced protocol cannot be reconstructed from the available matrix because the matrix potentially generates a great many different paths for its states.

If the strings are long enough, the calculated transition probabilities for the states are the same. Theoretically, this length is infinity. Only then empiricism coincides with theory, which is one of the thoughts contained in *Brouwer's theory of intuitionism* about the so-called current infinity.[11]

So far, we have discussed the generation of conclusions from premises and the reconstruction of premises based on the received conclusion. From the logic point of view, the problem raises an additional question, namely, when can the implication be reversed so that the one opposite to the straight line is true (known in relation to the discussed problem), when the first one is also true (and is also known). Then the encoding goes both ways. Logic gives such a procedure from the theory side.

In this area, it was formulated by K.F. Hauber (1775-1851), an important theorem, which has numerous practical applications (content interpretation of numerous real processes). It is called the closed system of implication theorem, and in fact it answers a practical question: when can a given finite system of implication be reversed? In other words: when the simple implications hold, then the inverse implications hold true.[12]

[11]*MarciszewskiW. (ed.), Mała encyklopedia logiki [in Polish], Wyd. NaukoweOssolineum, Wrocław 1988, pp. 74-77.*

[12]*This theorem will be illustrated by giving an example for three implications presented in the form of the following scheme:*

$$\begin{array}{c} p_1 \to q_1 \\ p_2 \to q_2 \\ p_3 \to q_3 \\ p_1 \vee p_2 \vee p_3 \\ \sim (q_1 \wedge q_2) \\ \sim (q_1 \wedge q_3) \\ \sim (q_2 \wedge q_3) \\ \hline q_1 \to p_1 \\ q_2 \to p_2 \\ q_3 \to p_3 \end{array}$$

6. Views on the Concept of Diversity in the Science of Organization and Management

At the end of the conducted arguments, one should take into account the representative views on diversity, representatives of the field of Management science.

Goals of management are planning, organizing[13], directing[14] or controlling[15]. Each of these goals does not have a homogeneous, compact content – in the sense of definition. Depending on the application to the field of management, it has a different character and content. Hence the goals of management and thus the entire science of organization management, is subordinated to the ontology of the diversity of nature, and not vice versa.

Concluding, the methodology of management science should use methodological knowledge about the category of diversity of the reality that surrounds us.

7. Complexity Theory

The problems related to the scientific category of diversity analysed so far are closely related in the scientific sense to the modern paradigm of science known as the Theory of Complexity. The concept of complexity was mentioned many times in the text, and in relation to mathematics and social sciences (humanities – linguistics and psychology). Currently, the mathematical understanding of the Theory of Complexity in content formulation will be presented.

Complexity theory is a theory dealing with a large number of seemingly independent factors that can spontaneously organize themselves into a coherent system. In a collection of objects of such complexity, there must be some hidden commonality that manifests itself under certain circumstances. How can this circumstance be even roughly located, or at least predicted?

Complexity itself can be a process or a dynamic object. People have the ability to recognize the qualitative aspect of a complex object without being able to accurately measure it, i.e. give formal measures of their quantitative (numerical) and analytical side (form) but also to understand their content – meaning. Trees, handwriting,

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[13]*The diversity of organization results from: implemented processes, their coordination in time and space, linking workstations in the organizational structure, ways of dividing work or creating teams to perform it, delegating responsibility and decision-making powers, organization of workspace and information transfer systems.*

[14]*The variety of management is dictated by the variety of factors affecting the quality of management such as: charisma, formal authority, competence or value systems.*

[15] *Diversity at the level of control refers to the variety of organizational knowledge resources surveyed during the inspections, or the set measures that are used to determine current effectiveness.*

riverbeds are all objects and processes with individual and general characteristics. The science of complexity states that they are different in detail but similar in concept (similar in content), that is, they are locally random but globally deterministic (Peters, 1997, p. 10; Prigogine and Stengers, 1990; Piaget, 1981).

Some of these objects in science have been called fractals. According to the definition adopted by Mandelbrot, objects (structures and processes) are self-similar (Mandelbrot, 1982). These properties are observed in many dynamic systems, for example in the global terrestrial ecosystem, social processes, speech and thinking systems. The existence of various features in systems or objects of Nature and their interaction, i.e. the creation and functioning of the above-mentioned structures, is called coherence.

Kauffman (1993) proposed that the spontaneous operation of coherent structures is a more likely explanation for evolution than the Darwinian theory of slow change (in a sense based on the notion of continuity). There are numerous examples of these spontaneous changes in nature and in social behaviour, in art, philosophy and natural language (law of Young Grammarians: Milewski, 1965, pp. 36-37; Gołąb, Heinz, and Polański, 1968, p. 350).

Traditional models cannot cope with their complexity and the emergence of these kinds of real-world situations.[16] Even mathematics, as part of its considerations, has created some structures for which it is unable to identify their diversity, i.e., complexity, and to provide unambiguous answers regarding their potential formal behaviour.

These are well-known undecidable problems in logic and metamathematics more generally (Grzegorczyk, 1969; Marciszewski (ed.), 1988). It can be said that this theory is evolving. After all, earlier, within the limits of possibilities, models, related methods and tools for studying the complex structures of reality were created in science. Currently, selected models of science used to describe complex processes of human activities (needs) will be presented.

If there is a need to make a decision when a large number of empirical data of a random nature is involved, then the first step should be to apply statistical analysis of these quantities, i.e. to adopt statistical thinking.[17]

[16]*People working independently of each other create a philosophical school (e.g. American transcendentalism), an artistic direction – impressionism. Similarly, a disorderly crowd of people can instantly turn into a cohesive crowd of common ideas, as if they were governed by one common mind. The group is able to do things that none of its members could do alone (Peters, 1997, p. 11).*

[17]*It has been pointed out so far that man has potentially many available ways of formulating ideas. With regard to statistical thinking (Ostasiewicz, 2012).*

Such an approach requires the researcher to be able to use appropriate statistical and other tools corresponding to the nature of the collected data. In explaining complex natural phenomena, due to the concept of randomness occurring only locally, the methods of multidimensional comparative analysis (MCA) turn out to be highly helpful. Although MCA is able to explain complex processes only to a certain extent (Panek, 2009; Peters, 1997), even such a partial explanation is better than none at all.

MCA fin numerous practical applications due to its simple statistical data requirements. It is enough to have a few variables – i.e., features of the same number, i.e., a certain number of examined objects – and then you can successfully use the research techniques mentioned and obtain interesting results in the form of interpretation in a new and smaller dimension compared to the original data.

In addition, these data can be both cross-sectional, i.e. taken at the same time from different places, and dynamic, i.e. recorded in different units of time. Qualitative and cross-temporal data (the so-called panel analysis) are also allowed for such an analysis.

The substantive basis of these methods boils down to several basic dimensions that create the complexity of the problem under study:

- The taxonomic dimension consists in ordering and grouping the studied objects.
- Factor analysis boils down to the presentation of a given set of features (usually random variables) of the examined objects of any nature, as a linear combination of new unobserved characteristics, called factors (components). These factors have an important property, they are orthogonal to each other, i.e., independent, and there are fewer of them than the variables, i.e. features, originally taken for analysis. Thus, they create a new spatial arrangement (Cartesian), which allows for the explanation and interpretation of the structure of connections between the features of the examined objects.
- Multivariate or multivariate analysis of variance (ANOVA, MANOVA). In general, a method that allows you to test, within a fixed number of factors, whether and how much they have an impact on the formation of the average values of measurable features of the examined objects and to study the interaction of these factors.[18]

The benefits of using MCA in the study of any process with the structure of objects - features listed above are as follows:

[18]*There are also nonparametric methods of analysis of variance. However, the strength of non-parametric tests is weaker than their parametric counterparts. The article emphasizes that the reality is complex and sometimes there is no other option than the use of non-parametric testing.*

- There is a reduction of the often huge amount of information about the examined objects to just a few basic categories that can be subjected to a more accurate statistical and content analysis,
- Obtaining homogeneous groups of objects and features in terms of their properties. As a consequence, this leads to finding (naming) their basic properties, i.e. expressing them in a new dimension,
- Focusing on the most typical phenomena, categories, features, etc., for the research problem under consideration,
- and most importantly – defining and explaining the structure of connections between the features of the examined objects, as well as between the objects themselves due to the features represented by these objects.[19]

8. Summary and Conclusions

Science uses many concepts. They are not all equally important. But in the whole of science, two of them play a fundamental role. These are knowledge and information. Science, as we have seen in individual points of the text, does not have strict definitions of both of these concepts, because they are complicated in the sense that they occur everywhere, in every human activity. Intuitively speaking, however, information is a less precise concept than knowledge, but it has a very great carrying power for our consciousness.

Our human mind absorbs information more easily than knowledge, because you have to acquire it yourself, and information can even be bought. In the context of the above considerations about information, we will refer to Copernicus' theory, because it was through information that it changed our human view of the world, although not everyone has to have it and not everyone has knowledge about it, but they have information.

Nicolaus Copernicus through his theory (language) changed the thinking of all mankind, but through mathematics and information (knowledge) about the structure of soil planetary system. The methodology of knowing reality is as long as civilization is in the historical record. And from them we know that man has always tried to know and understand the behaviour of reality.

But, the question arises why does it do this? Getting to know reality, through its limitations, we achieve a state of balance with it and then we know how to proceed and further properly organize our structures and manage them well. And at the end of the conclusion of the text, it should be emphasized that this is a diverse approach to the ontological category which is the diversity of Nature.

Diversity generates other diversity, which is something like the paradigm of self-organizing systems. This feature is the dynamics of the world. But in the end it is

[19]*Many of these methods are applicable to multi-criteria programming (and data analysis).*

always sort of orderly and organized. Because it is the ontology of diversity that is able to generate the dynamics of nature and its stability (structure) at the same time.

Therefore, it is now possible to see (interpret) and define additionally, in a way, the basic features of the science of management, such as planning, organizing, directing or controlling, in the dimension of the category of diversity. And so, the variety of strategic decisions taken, e.g. during planning, will be determined by the variety of defined goals, directions of the organization's activities and resources necessary for their implementation.

Paraphrasing the definition of planning presented by Nioche Ghertman and Laroche, diversity at the planning level will affect the diversity of the future, which results from the diversity of decision-making problems and the diversity of ways of solving them. So planning is as complicated as the diversity of the world shown in the text is complicated. In specific cases, he uses various forms of organization of the examined objects.

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